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ADVANCE	D REAR PROJECTION VIEW	<i>I</i> ER	
	December 1965		
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New American	9965 3302		
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	Approved by		
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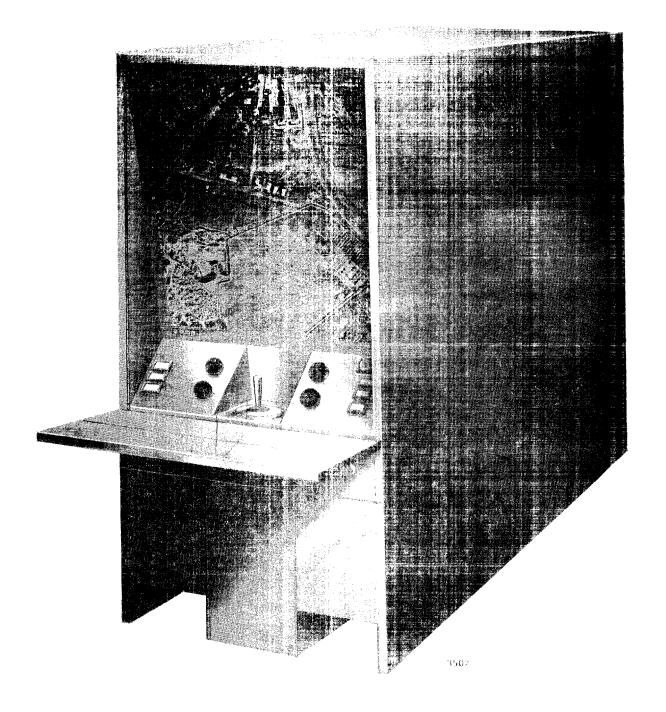
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Form 7 (R 8-64)



ADVANCED REAR PROJECTION VIEWER

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		STA [·]
	INTRODUCTION	
STAT	is pleased to submit this proposal for an Advanced Rear Projection Viewer in response to the Statement of Development Objectives, dated 28 October 1965.	
STAT	has designed and built screening viewers and associated equipment for the photo-interpreter since 1959. Throughout this time, steady progress has been made towards extending the state of the art in all the technologies applicable to viewer design. The advanced viewer proposed herein culminates this work. It will provide in a functional package many features previously unattainable, among them resolution, distortion, image brightness, and uniformity. The proposed rear projection viewer is built around a screening viewer already developed by incorporating its advanced optical concepts, film transport, and control features.	STA
STAT	has pioneered in the design of optically compensated zoom lenses. These mechanically simplified systems find natural application in the proposed viewer. The condenser system design has its roots in a simulator of the earth and moon designed and built by for the Jet Propulsion Laboratory as part of the RANGER program. This experience permits confident derivation of the performance to be expected from the proposed design.	STA
	The following sections introduce the viewer generally and proceed to a detailed discussion of the major subsystems. The design choices are described in sufficient detail to permit the reader to follow the reasoning behind each decision.	
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		·	Top	ics			
•		Variabl	e Magnif	ication Met	hods		
5-8-3	A	Autofocus and	Zoom Sys	tems Briefl	y Described		
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VARIABLE MAGNIFICATION METHODS

The design of a screening viewer with variable magnification pivots upon the choice of the projection optics. There are two options: autofocus systems or zoom systems. In the first, object and image conjugates are changed holding lens focal length fixed; in the second, lens focal length is the parameter modified.

has designed and built screening viewers employing both classes of optics.

In fact, the difficulties intrinsic to autofocus systems led to undertake a fresh study of the zoom approach. This work

yielded a mechanically simplified zoom lens design since validated by practical hardware experience.

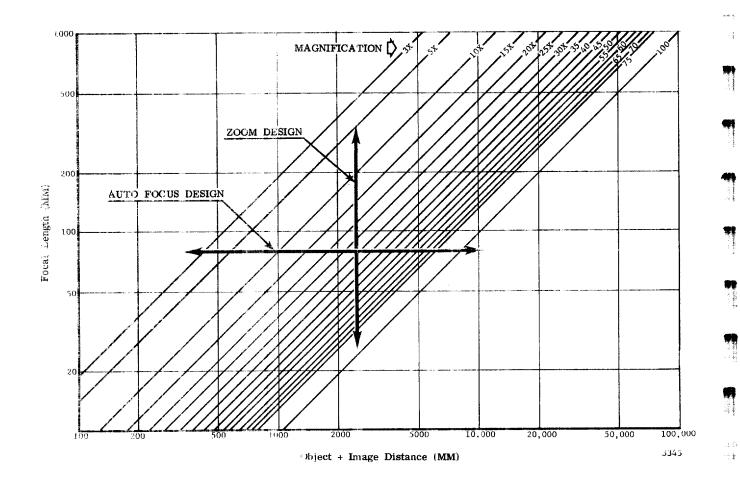
optics into the advanced rear projection viewer. This section explains the alternatives and develops the tradeoff factors which led to this decision.

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¹JOSA, <u>55</u>, 5, pp 347-351, April 1965







OBJECT PLUS IMAGE DISTANCE VERSUS LENS FOCAL LENGTH FOR VARIOUS MAGNIFICATIONS

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AUTOFOGUS AND ZOOM SYSTEMS BRIEFLY DESCRIBED

Variation of magnification may be achieved optically by one of two methods: either change of object and image conjugates for a fixed focal length lens, or change of focal length holding overall conjugate distance constant. When the first method is accomplished while maintaining a sharply focused image, the technique is called "autofocus." The second method utilizes variable focal length lenses, and is commonly called "zoom." The facing figure graphically displays the well-known lens formula governing both designs.

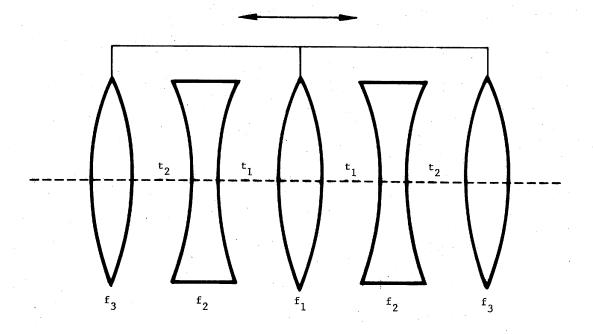
Magnification by autofocus is represented by a horizontal line on the figure. Conjugate distance, increasing with magnification is usually varied by cams. Mechanical accuracy is vital to sharp focus, and even normal wear must be compensated. Autofocus forces a tradeoff between overall conjugate distance and field of view. Short focal length lenses cannot cover the large format; long focal length lenses suitable for the format entail excessive conjugate distance. Therefore, large magnification ranges must be covered by a family of separate lenses of different focal lengths but similar conjugate distances.

Magnification by zoom is represented on the figure by a vertical line. The elements of the lens are moved relative to each other so that the individual conjugate distances change and vary the overall focal length. Since the overall conjugate distance is constant, the focal plane is fixed.

STAT engineers are able to optically compensate zoom lenses and thus eliminate all need for cams. The lens set moves as a unit and differential motion is avoided. This approach to zoom design is compatible with high magnification ranges and to large fields of view.

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SYMMETRICAL FIVE-COMPONENT ZOOM LENS WITH NEGATIVE FIXED COMPONENTS

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	PROPOSES A ZOOM SYSTEM
	nreceding comparison of autofocus and zoom lens systems validates selection of the zoom lens mode for the advanced rear projection wer. Explicitly, the reasons for this choice are:
•	Mechanical simplicity of the zoom system: No cams or complex mechanisms are needed to move the lens elements. The overall distance between file and screen remains fixed.
•	Zoom lens provides a constancy of focus: No mechanical wear or misalignment can cause focal shift. Focal shift is controlled by design rather than by precise mechanical parts.
•	The zoom lens principle of changing focal length is compatible with large field requirements at low magnification and with high numerical aperture and resolution at high magnification.
•	optical designers are experienced in the design of advanced zoom lenses.
•	The zoom lens offers a smaller physical configuration.
att res	liminary design indicates that two zoom lenses will be necessary to ain the high degree of lens correction compatible with the viewer's olution design objectives. At least three fixed focal length lenses ld be needed to achieve a comparable autofocus system. Thus, the final

Zoom lenses afford simplier and more efficient viewer design and operation and require less changeover time between magnification ranges.

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reason:

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SECTION 3

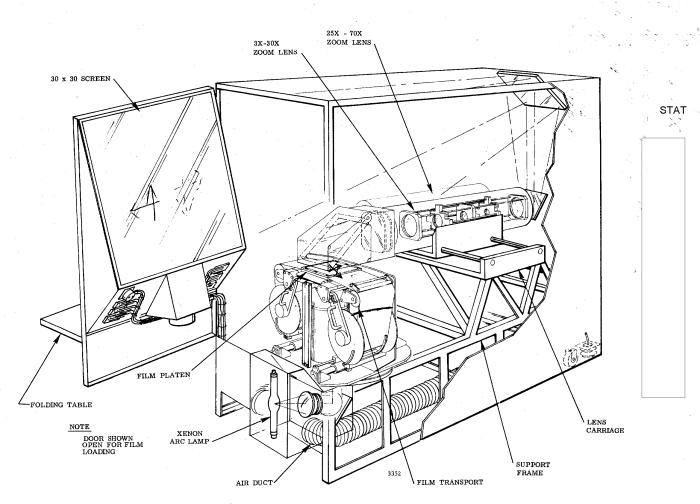
PROPOSED ADVANCED REAR PROJECTION VIEWER - GENERAL DESCRIPTION

Topics

Operational Features
Electrical and Cooling Module
Tabulated Performance Data
Illumination System
Projection Lens System
Film Transport
Control Stick and Panel

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OPERATIONAL FEATURES
The rear projection viewer proposed by incorporates the desirable features expressed in the development objectives. The equipment is a definite advance over current viewers and will enable a substantial increase in the information transfer between photograph and the photo interpreter. The design philosophy requires that the viewer be an instrument to enhance the interpreter's inherent capabilities by providing a tool to circumvent his physical limitations and reduce to a minimum his manual, time-consuming tasks.
Film loading is conveniently accomplished through the open front door, with the film transport close to the operator at a convenient height and all control knobs readily accessible. The simple threading path will permit loading in two minutes or less. The film transport may be operated with the door open to permit observation of the transport under dynamic conditions.
The layout of the control panellocation of controls, knobs, and switchesthe height of the work surface, and relationship of the screen have been carefully considered by human factors engineers for an optimum man-machine relationship. The most frequently used controls are grouped near the center to facilitate right or left hand operation, or by either of two operators jointly using the equipment. The large work table provides ample room for reference material and writing space. It is hinged to fold down when desired.
All elements which require routine cleaning and periodic service are accessible from the front. A service light illuminates the interior of the viewer during these operations.
Replacing the xenon arc lamp is also accomplished from the front via a loading door.

Replacing the x Safety features, interlocks, and automatic sequencing have been incorporated to the maximum extent to preclude unsafe or improper operation of the equipment.

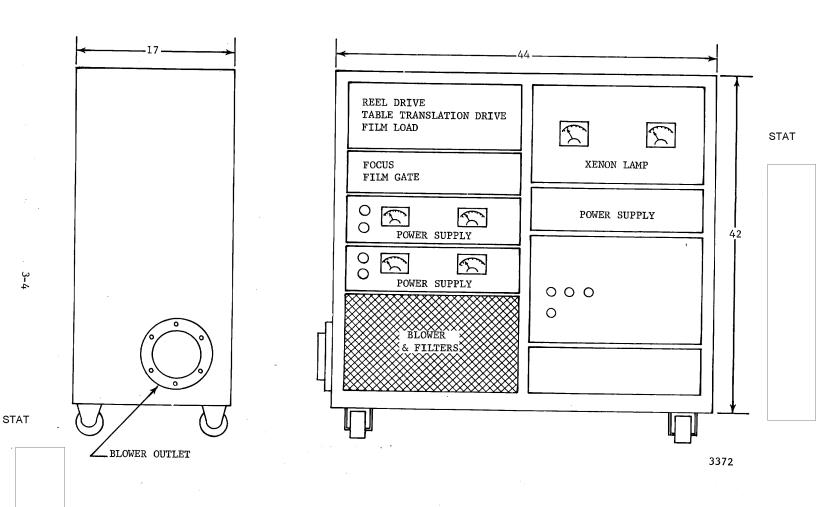
High performance of the viewer dictates that all elements of the optical system be held in rigid alignment. Failure to do so would result in degradation of resolution or loss of focus even though the optical system were fully capable of meeting the desired objectives. Most viewers in the past have been designed to fit within a sheet metal enclosure. The enclosure formed the primary structural member and only incidentally excluded dust and foreign matter.

To conserve the intrinsic performance of the optical system, mount all optical elements together with the film transport upon a rigid primary The enclosure panels will serve only as nonload bearing skins designed to exclude dust and to control stray light. The upper front portion of the structure enclosure, including the screen control panel and desk, will be hinged at the side to form a large door, opening into the interior of the viewer. This arrangement permits easy access for film loading, routine cleaning of the optical elements, and accessibility to the rear side of the control panel.

Vibration isolation is accomplished by four inflatable pneumatic mounts which serve both as isolator and jack to lift the enclosure up and off the casters.

Moving the viewer to another location requires only disconnecting the air duct and cables from the electrical and cooling module and deflating the air vibration mounts It will be possible to readily accomplish this within the fifteen-minute time limit stipulated in the development objectives.

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ELECTRICAL AND COOLING MODULE

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ELECTRICAL AND COOLING MODULE				
The electrical and cooling module includes the xenon arc lamp power supply and has been designed as a separate module for the several reasons given below:				
 A greater degree of flexibility in the installation arrangement of the viewer since only access to the front is required. 				
The electrical and cooling module may be located in an area where it is readily accessible for servicing of air filters and other routine maintenance.				
 It is possible by having a spare electrical cooling module, to service this unit with a minimal down time of the viewer itself merely by exchanging electrical and cooling modules. 				
 The electrical components most sensitive to heat are removed from the lamp, the primary source of the heat, thereby assuring better cooling of the electronics and consequent longer life. 				
 All the rotating machinery required for cooling the lamp is external to the viewer so that vibration from this source will not be introduced into the viewer. 				
The electrical and cooling module is mounted on casters so that it also may be readily moved from one area to another. Quick disconnect duct fittings and cable connectors permit rapid hook-up of the viewer with the module.				
Alternatively, the individual components of the electrical and cooling module could be distributed within the main viewer housing does not recommend this choice because most of the advantages listed above are voided. In addition, the mechanical integrity of the viewer support structure may be compromised.	STAT			

compromised.

ADVANCED REAR PROJECTION VIEWER, TABULATED DATA

Film Sizes

Roll film, all widths 70 mm to 9.5 inches wide

Film Types

Thin and standard base; black and white or color transparencies; infrared or radar negatives

Film Capacity

Maximum 1000-foot spools - AF Standard 51C17848

Magnification

Low Range - 3x to 30x continuously variable

High Range - 25x to 70x continuously variable

Changeover Time

5 seconds, approximately

Resolution

Focus

Automatic throughout magnification range or range change -- manual override to accommodate emulsion up or down

Image Rotation

±180 degrees continuous

Screen Brightness

20 foot-lamberts at 70x with 1.5 ND film

Illumination Uniformity

Less than 10 percent falloff, except at extreme corners at 3x to 3.7x

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Screen Size

30 x 30 inches

Image Positioning

Any point on 9.5-inch film can be brought to screen center at all powers

Film Speeds (Forward or Reverse)

High Range (Slew)

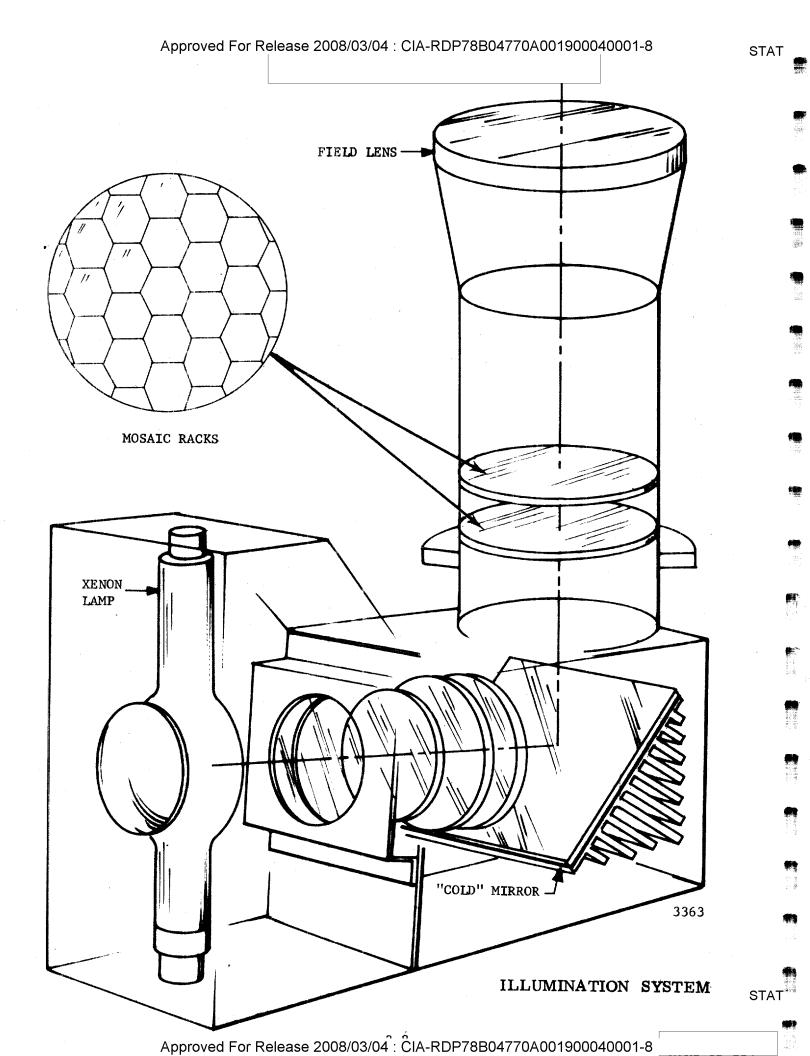
0.9 to 40 in/sec parallel to film 0.05 to 2 in/sec transverse to film

Low Range (Scan)

0.002 to 2.0 in/sec parallel or transverse, constant sensitivity at all magnifications

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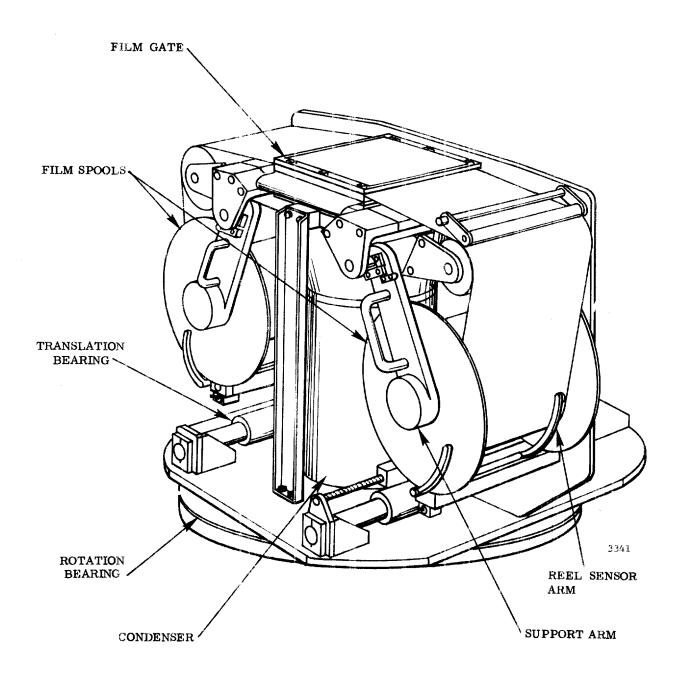
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Viewer Dimensions	Height 74 inches; depth 84 inches; width 36 inches (34 inches with panels removed) Center of view screen is 53.5 inches high
Viewer Weight	1500 pounds maximum
Power and Cooling Module	Height 36 inches; depth 24 inches; width 44 inches
Power and Cooling Module Weight	500 pounds
Power Requirements	3.5 KVA, 208/230V, 60-cycle, three-phase



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ILLUMINATION SYSTEM				
The proposed rear projection viewer will meet the design objectives through the use of a new illumination system recently proven by in another STAT program. The requirement to produce a screen brightness of 20 foot-lamberts with 1.5 ND film and to have a minimum color temperature of 3400°K will be satisfied by a 2500-watt xenon arc lamp. The requirement for illumination uniform to 10 percent will be filled by a novel mosaic condenser arrangement. The individual mosaic elements act to distribute the flux across the entire film gate. The last element of the system is fixed to and rotates with the film transport. This arrangement permits minimum sized elements to cover the entire 9.5-inch format.				
The condenser lens mounts are designed to accommodate thermal expansion without damage to the elements. The xenon arc lamp is enclosed in a metal housing for safety and a thick, tempered window forms its port. A "cold" mirror reflects the visible energy to the film plane while transmitting the infrared into a radiator attached to its rear surface. When the film transport is in the LOAD position, a shutter is automatically inserted into the light path. This feature eliminates the need to frequently turn the lamp on and off and thereby extends the life of the lamp.				

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PROJECTION LENS SYSTEM	
The proposed Advanced Rear Projection Viewer will be equipped with two optically compensated zoom lenses. Analysis shows that one lens would easily cover the magnification range, but would suffer from impaired resolution and distortion at the higher powers. Therefore, one lens will be optimized for the 3x to 30x range where the field of view is large. and the second will be designed for the 25x to 70x range. It is experience that the lower power will experience a greater duty cycle than the higher power, the latter being used primarily for close inspection of selected imagery.	STAT
Both zoom lenses are mounted on a motor-driven carriage capable of placing either in the optical path. Selection is by a front panel switch. Provision is made for accurate indexing commensurate with system alignment, focus, and magnification requirements. Changeover from one to the other will require approximately 5 seconds.	
The folding mirror between the film platen and the projection lens assembly is hinged for better access to the film gate. Swung up, it is out of the way for loading film and cleaning operations. Precision stops accurately index the mirror when it is returned to position.	



FILM TRANSPORT ASSEMBLY

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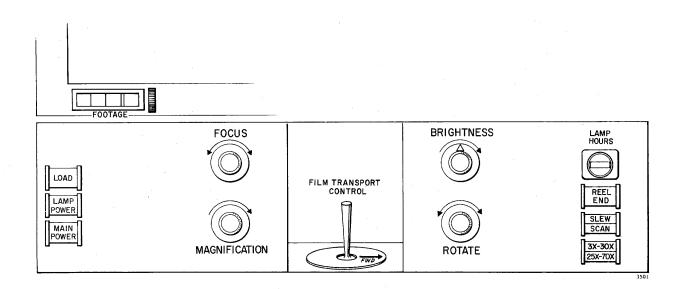
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FILM TRANSPORT SYSTEM

The proposed advanced rear projection viewer is provided with a film transport of proven design. The transport moves the film both parallel and transverse to its length, and by rotation of the entire assembly, rotates the viewed image. Each motion is controlled from the front panel.

The LOAD control automatically rotates the film transport to place the spool flanges facing the operator and translates the mechanism toward the front. The film spool support arms swing up and out of the way during loading. The arms can be locked in an infinite number of positions; therefore any film width between 70 mm and 9.5-inches can be accommodated.

Film threading is extremely simple and provision is made for selectively winding the film with emulsion in or out on the take-up spool. Because of the straightforward film path and minimum roller contact with the film, the possibility of scratching film is greatly reduced. A unique feature of this film transport is that all film motion along the length of the film is accomplished by winding or unwinding the film from the spools. This eliminates the capstan drive, which is a major source of film scratches resulting from the scuffing action of the friction roller during acceleration or deceleration.



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REAR PROJECTION VIEWER CONTROL PANEL

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CONTROL STICK AND PANEL

The controls concerned with the dynamic operation of the viewer are located on the control panel just below the viewing screen. The controls have been grouped to provide the operator with a convenient and logical layout of the operating functions. The arrangement represents initial design choices and is subject to modification at the customer's direction in the detailed design phase. The description and function of the controls are as follows:

An indicating press to make, press to break switch that controls

power to the viewer unit.

Lamp

An indicating press to make, press to break switch that controls

application of the projection lamp power.

Load

An indicating press to make, press to break switch that positions the film transport for loading. It also introduces a shutter into

the optical path of the condenser system.

Film Footage

Indicates the elapsed footage directly. Can be reset to zero when

desired.

3x - 30x / 25x - 70x

An indicating press to make, press to break switch that selects the

desired magnification range.

Magnification

An on-off-on (return to off) type switch to increase or decrease

the variable magnification.

Brightness

A potentiometer type control to increase or decrease the projec-

tion lamp current, hence its brightness.

Lamp Hours

An elapsed time meter to record the operating hours of the xenon

projection lamp.

Focus

An on-off-on (return to off) type switch that permits the operator

to adjust the optimum image focus.

Rotation

An on-off-on (return to off) type switch that controls the image orientation on the screen, and the orientation of the control

stick reference ring.

Slew/Scan

An indicating press to make, press to break switch that in the slew position enables the increase in the film speed. Scan is

normal operating mode.

End of Reel

An indicator that warns that the end of the film is approaching

and that the slew mode has been disabled.

Film Transport Control

This is the control stick that controls the film movement in x and y directions. The direction is directly related to the direction of movement of the stick and speed is directly related to the magnitude of the deflection. Other functions may be incorporated

if desired.

SECTION 4

PROPOSED REAR PROJECTION VIEWER

DETAILED DESCRIPTION

Topics

Selection of the Projection Lamp

Xenon Arc Characteristics, Problems and Solutions
The Mosaic Condenser System
Xenon Arc Lamps and Ozone Formation
Thermal Management of the Xenon Lamp

The Projection Subsystem

Resolution

Modulation Transfer Function

System Resolution Trade-offs

Projection Screen

Screen Brightness

Focus and Its Control

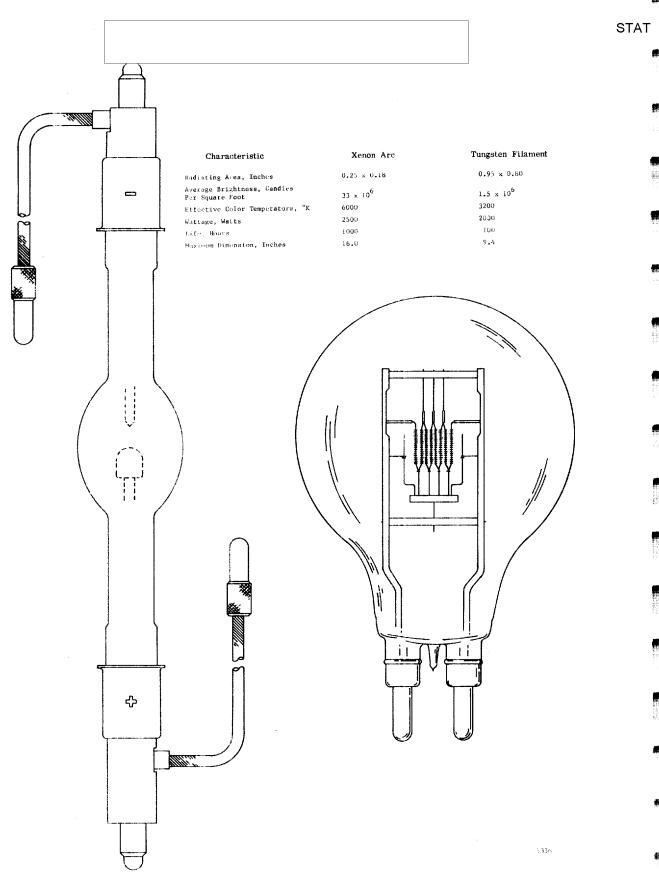
Distortion

Control Subsystem

Controls -- General Description
Magnification Drive and Control
Focus Drive and Control
Reel Drive and Control
Film Transport Control
Rotation Drive and Control
Translation Drive and Control
Film Gate Drive and Control
Film Gate
Illumination System Control
Structure and Enclosure

SELECTION OF THE PROJECTION LAMP	
SELECTION OF THE PROJECTION LAMP	

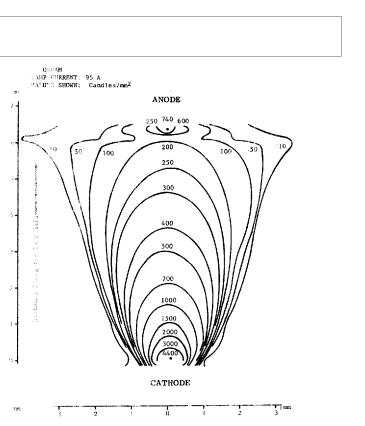
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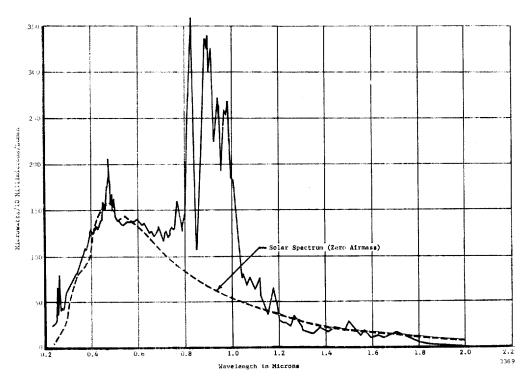
PROJECTION LAMP COMPARISON

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	SELECTION OF THE PROJECTION LAMP
having an offill the fill the fill the fill as uniform approximate signed for offer advan	projection viewer requires a source of very intense illumination effective color temperature of 3400°K or greater. In order to ilm gate uniformly, the radiating area should be as large and as possible. There are only two types of light source which the necessary qualities: large tungsten filament lamps despot light service, and high pressure xenon are lamps. Both intages balanced by certain disadvantages. The facing figure the two candidates to scale and the table compares their estics.
operated was	radiating area is large, the tungsten filament cannot be with reasonable life at 3400°K. It will be shown in a succeeding lat only the xenon arc satisfies the stated brightness requireremains to circumvent the small, nonuniform radiating area.
xenon arc Nortronics	is now designing and constructing for projection system using 4x to 200x zoom optics and a custom lamp having a longer arc than normal. In this and related work, has developed special condenser optics which make it practical smaller source to cover large formats.
	the advanced rear projection viewer will employ a special xenon
arc lamp an	nd optical designs qualified by experience on similar. The following sections relate the approach in detail.



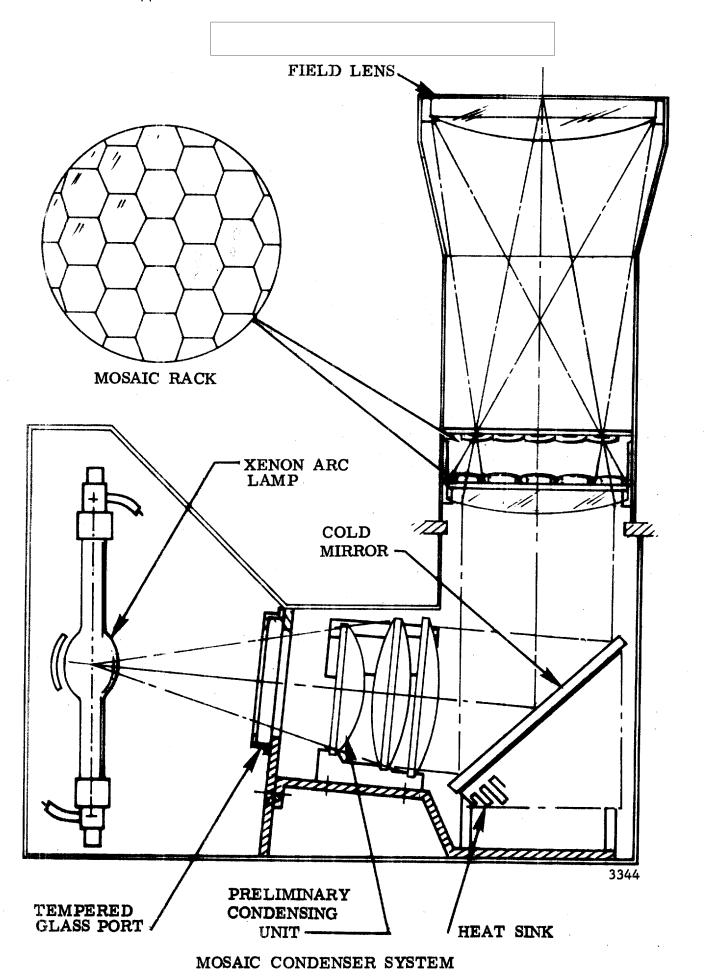
XENON ARC BRIGHTNESS DISTRIBUTION



XENON ARC SPECTRAL ENERGY DISTRIBUTION

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	XENON ARC CHARACTERISTICS, PROBLEMS, AND SOLUTIONS
	The xenon arc is the hot, intense light source needed by the advanced rear projection viewer. Xenon radiates a continum through the visual region which very closely matches that of a 6000°K black body as shown at the top of the facing page. Xenon gas has a low specific heat; therefore, it reaches equilibrium temperature so rapidly there is no warm-up period. Luminous output varies with current without significant change in the spectral content. A range of two to one in output is nominal. Therefore, the xenon arc fully satisfies the development objectives of a controllable source with a color temperature always greater than 3400°K.
· · · · .	The xenon arc, like other arcs, however, is a small, nonuniform light source as suggested by the figure at the bottom of the facing page. Both features are impediments to a condenser system required to fill a large film gate with uniform illumination. Fortunately, there are remedies.
STAT	is now procuring on another program, a special xenon arc lamp having wider than usual electrode spacings and hence a larger arc. A similar special lamp is planned for the advanced rear projection viewer. The key to the uniformity problem, however, is a unique condenser STAT system employing a pair of mosaic lens arrays. It is described in detail on the next page. The combination of an enlarged xenon arc and creative condenser design will provide the brightest possible screen with optimum uniformity.
STAT	It is experience that the human eye does not perceive brightness gradients in normal imagery even when the edge fall off is measured to be as much as 50 percent. Hence, the design objective of only 10 percent departure from the maximum value should be viewed in this perspective. Nevertheless, will adopt the 10 percent value as a design goal because current experience indicates that is may be closely approached.



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THE MOSAIC CONDENSER SYSTEM
The necessity to obtain uniform illumination from a xenon arc is not new Several years ago the problem was solved in the design of an Earth-Moon Simulator built for the Jet Propulsion Laboratory on the Ranger program. This instrument employed a mosaic lens condenser system. Measurements across its 6.5-inch diameter film plane showed a center-to-edge fall off in illumination of only three percent. The facing figure shows how this proven method will be adapted to the advanced rear projection viewer.
Two racks of mosaic lenses form the heart of the system. The first rack intercepts the rays from the condensing optics and forms multiple images of the xenon source in the aperture of the second mosaic array. Each lens in the second mosaic reimages each individual aperture of the first array over the full film frame. Superimposed over the film plane, then, is a multiplicity of images, each covering the entire frame. Each contributes the illumination from a fractional part of the entire beam collected by the preliminary condensing unit. A field lens adjacent to the film plane redirects the diverging rays to fill the exit pupil of the projection system throughout its magnification range.
Since the primary bundle is dissected by the first mosaic rack, and each portion is distributed by the second array over the entire film frame, the uniformity is a function of the number of mosaic elements. The mosaic arrays built for each contained 19 major elements. The optimum number for the advanced rear projection viewer will be determined in the initial phases of the proposed program.

KENON ARC LAMPS AND OZONE FORMATION

The ultraviolet radiation of a xenon arc lamp can disassociate molecular oxygen to form free ozone. Ozone is the strongest oxidizing agent known; plastic materials (photographic film) and rubber compounds are rapidly deteriorated by it. One part in ten million is recognizable by its distinctive odor, and this concentration is recommended as maximum permissible. Two parts per million are considered to be toxic.

The ozone problem will be eliminated in the proposed rear projection viewer through the use of a lamp with a special quartz envelope. This envelope material is opaque to wavelengths of 2500 Å and shorter. Thus, the short wavelength energy which is active in ozone production is contained within the lamp and cannot escape to cause damage. Filters external to the lamp would be ineffective because the ultraviolet would activate the air between the lamp and the filter.

THERMAL MANAGEMENT OF THE XENON LAMP

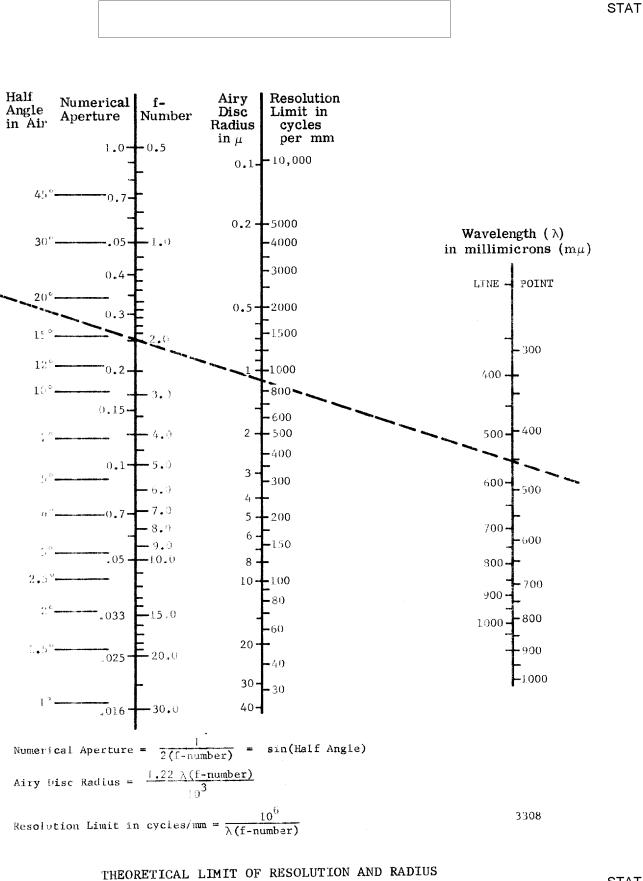
The xenon lamp attains full brightness within a few seconds after ignition, and its substantial thermal energy is an unsought by-product. The heavy electrodes in the lamp are designed to conduct much of the heat through the envelope for convective and radiative transfer. Forced air cooling will be provided to the lamp by blowers located in the Electrical and Cooling Module to isolate their vibration from the viewer. The blowers will operate at all times when the lamp is energized and will remain on for a short time when lamp power is turned off to avoid a temperature buildup. Coupling to the viewer will be by flexible ducting. The air path around the lamp will be designed to maximize thermal transfer and to prevent undesirable hot spots. A thermal switch will be located within the condenser assembly to sense excessive temperature and turn off the power supply in case of malfunction. By these means, the lamp will be maintained below the maximum temperature specified by the manufacturer.

The film gate will be protected from the infrared radiation of the lamp through the use of a "cold" mirror which reflects the visual energy to the film and transmits IR out of the optical path into a thermal sink. In addition, heat absorbing filters will be placed between the lamp and film gate. In this way the film temperature will be kept at a 100°F or below as specified.

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	THE PROJECTION SUBSYSTEM	
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THEORETICAL LIMIT OF RESOLUTION AND RADIUS OF AIRY DISC FOR A PERFECT LENS

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RESOLUTION

Because the unaided human eye can only resolve about 10 line pairs per millimeter, magnification is called for when better resolution is needed. Today, high quality microscope techniques can achieve as much as 700 line pairs per millimeter over very small formats. There is a trade-off set by the wave nature of light which relates the resolution, R, to the relative aperture (f/no.) of a perfect optical system.

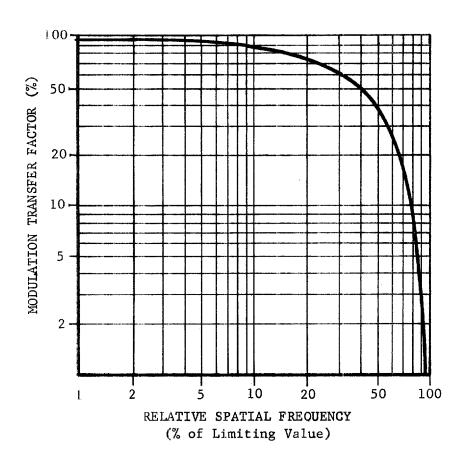
$$R = \frac{10^6}{\lambda(f/no.)}$$
 cycles per millimeter

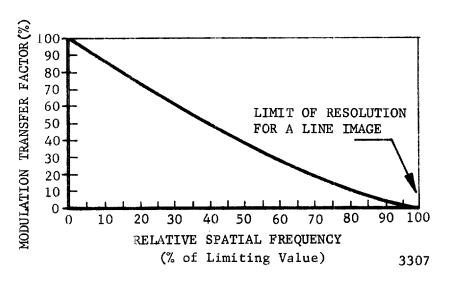
where λ is the wavelength in millimicrons. The facing figure is a nomograph of this relationship and shows how only low f/numbers, or fast lenses are commensurate with high resolution.

Fast lenses, however, are well-known for their severe aberrations. In general, axial correction is traded off for extra-axial imagery, or vice versa. Both cannot be maximized simultaneously. Therefore, when planning, not for a microscopic system, but for a film plane 9.5 inches square, the optical designer must be prepared to permit lower resolution in exchange for excellent off-axis distortion throughout a large magnification range.

has designed a number of projection systems for screening viewers similar to that proposed. Up to 300 line pairs have been achieved at up to 100 power magnification. Through careful design and the use of two zoom assemblies each optimized for a portion of the magnification range, it is felt that a practical design objective is 420 line pairs per millimeter. The minimal effects of the associated distortion are treated in a following section.







MODULATION TRANSFER FUNCTION

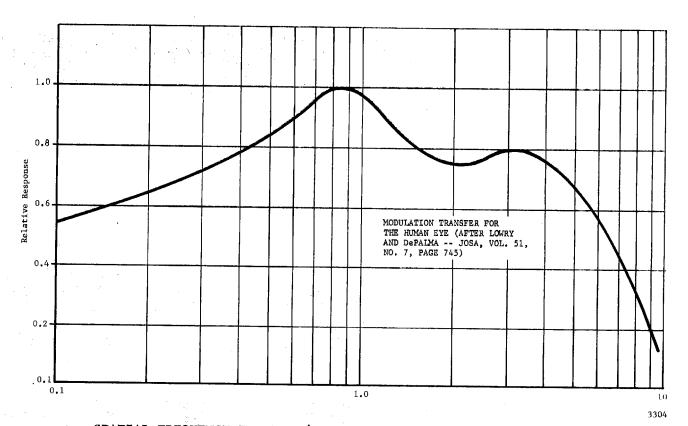
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MODULATION TRANSFER FUNCTION

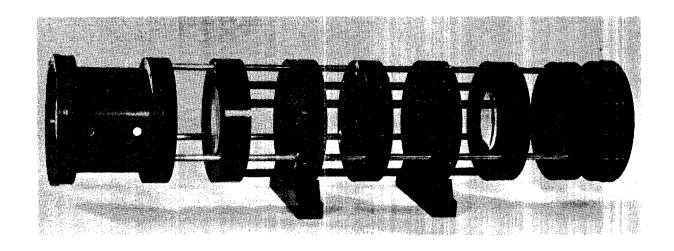
During recent times, the optical community has adopted the modulation transfer factor technique from electronics as a means of providing a more quantitative evaluation of optical systems. Through its use, the overall system response can be obtained by taking the product of the responses of the individual elements. The figures on the facing page show the relationship of transfer factor and spatial frequency for a perfect or diffraction limited lens. It may be observed that the classical Rayleigh limit of resolution is achieved when the modulation transfer factor equals zero. The performance of a system may, of course, be unacceptable before this point is reached.

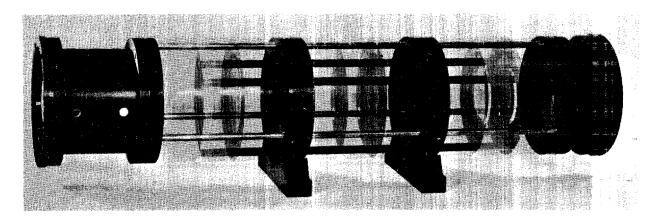
The eye itself has a transfer function that falls to zero at approximately 10 lines/mm as shown in the figure at the bottom of this page. It is, therefore, necessary to use auxiliary magnification when working with visual systems having spatial frequencies near or exceeding that of the eye. It has been found that a response function of visual instruments must be at least 10 to 15 percent for the eye to detect modulation. The curve on the facing page shows that at 10 percent modulation transfer factor, the corresponding relative spatial frequence is 80 percent of the limiting value. Thus, if the system is to display 700 line pairs per millimeter to the observer, it must be designed for a (700)/(0.80) = 875 line pairs per millimeter limiting resolution.



SPATIAL FREQUENCY IN LINES/MM AT 14 INCHES VIEWING DISTANCE

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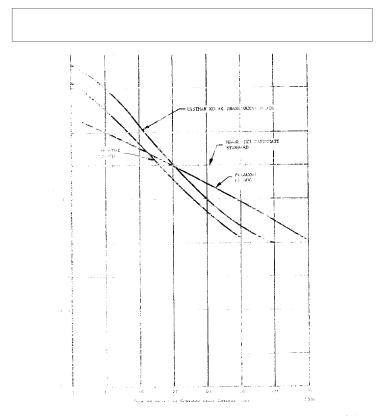
ZOOM LENS

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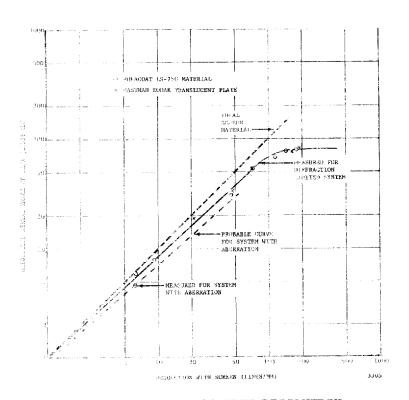
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		STAT
	SYSTEM RESOLUTION TRADE-OFFS	
STAT	The advanced projection viewer design objectives require 10 line pairs per millimeter per power; at 70 power, 700 millimeter are expected. As noted on the previous page, increased to 875 line pairs per millimeter to accommodate the nomograph on page 4-10, it is seen that for the media 550 millimicrons, an f/2 lens system is called for. Other ponents such as mirrors and the screen all have transfer than unity. Compensation for these elements would theore optics approaching f/1.5. Because of the great difficult adequate correction as lens speed increases, f/2 is consistent to be a practical limit for the projection system.	line pairs per this value is the eye. From an wavelength of er optical com- factors less etically require y in achieving
STAT	As magnification increases, the view screen itself become field stop and the format covered in the film plane is reprojection lens design will exploit this fact to optimize excellent resolution needed at higher magnifications. At cations, the requirement for resolution is proportionated the lens design will be optimized for increased format. has experience in this trade-off technique and the design of zoom lenses in the ranges of 10 to 1, 33 to Resolution up to 300 line pairs per millimeter has been pup to 9.5 inches square have been accommodated. The excethe advanced rear projection viewer will require the use zoom lenses. One will cover the magnification range from the other will cover from 25x to 70x. Each lens will be its range and will produce the best resolution permitted state of the art. At the highest power, design resolution will be 420 line pairs per millimeter.	educed. The for the lower magnifi- y reduced and has used it in l and 50 to 1. rovided and formats ptional imagery of of two separate 3x to 30x and

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CHARACTERISTICS OF PROJECTION SCREEN MATERIALS



REFECT OF VIEWSCREEN UPON RESOLUTION

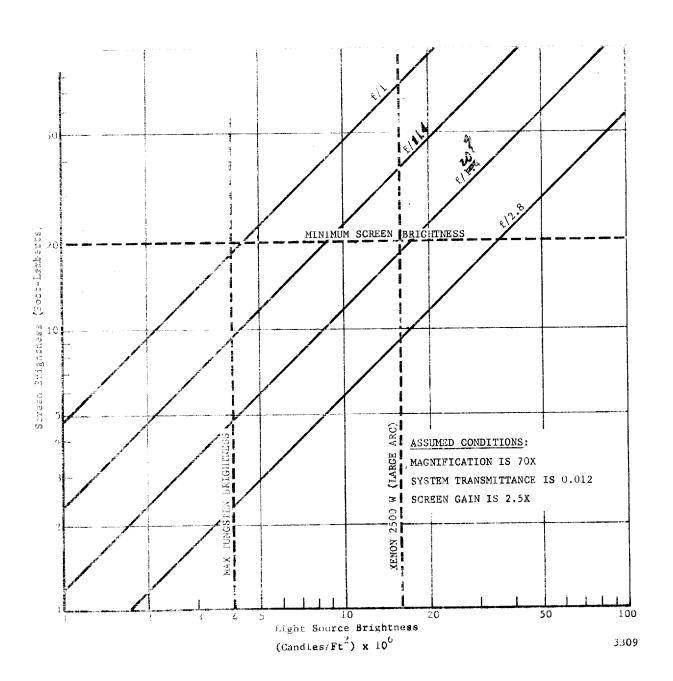
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	PROJECTION SCREEN	
	The figure at the top of the facing page shows the characteristics of several possible projection screen choices. The figure shows that a screen with a high gain factor also has a rapid fall-off of extra-axial luminance, and a screen that is capable of providing uniform wide angle luminance does not provide a large gain factor.	
	Normally, the selection of screen material is not as critical as that of the proposed system since the loss of screen gain for wide angle viewing is offset by a more intense illumination system or a larger aperture projection lens. However, the requirement for a high screen luminance with film having a neutral density of 1.5 (transmission = 3.2 percent) and the requirement for high resolution have already necessitated the use of the brightest light source and largest aperture ratios possible. Thus, a screen gain of greater than unity is considered to be vital even with its inherent loss of luminance as viewing angles become large.	
STAT	considerable experience in the field of projection viewers has shown three screen materials to be superior, namely: Polacoat Lenscreen LS-60 and LS-75 and Eastman Kodak Translucent Plate. The latter two materials have higher gains and are not as suitable for large angle viewing as LS-60. Polacoat LS-60 will be used because it will permit meeting the screen brightness requirements and will produce optimum performance at wide viewing angles. will carefully select the screen stock for uniformity and gain.	STAT
STAT	A further consideration of screen selection is that of its transfer factor. has found by special testing that the screen material produces a deterioration of imagery at the higher spatial frequencies. The figure at the bottom of the facing page illustrates the intrinsic conflict between wide angle viewing and high resolution. The very fine grain screen needed for high resolution produces a highly directional beam at the screen as well. Polacoat LS-60 is also optimum from this standpoint.	





SCREEN BRIGHTNESS VERSUS SOURCE BRIGHTNESS FOR VARIOUS f-NUMBER RATIOS

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SCREEN BRIGHTNESS

Screen brightness is related to the other parameters of the system by the equation

$$B_S = (G)(E_S) = \frac{G t B}{4(f/no)^2 (1 + M)^2}$$

where:

 B_S = Screen brightness = 20 foot-lamberts (specified)

G = Screen gain = 2.5 (Polacoat LS-60)

 $E_S = I11umination at the screen in foot-candles$

= (0.4)(0.03) = 0.012

where transmittance of system optics is 0.4 transmittance of ND 1.5 film = 0.03 (specified)

M = Magnification = 70 maximum (specified)

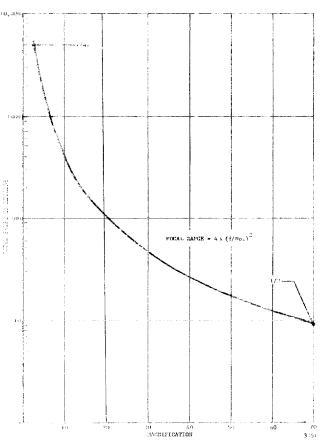
The figure on the facing page relates source brightness to screen brightness for several projection lens aperture ratios. It will be seen that only a xenon arc lamp in conjunction with an f/2 projection lens will satisfy the design objectives. proposes to use both a special xenon lamp and f/2 zoom projection optics as previously described.

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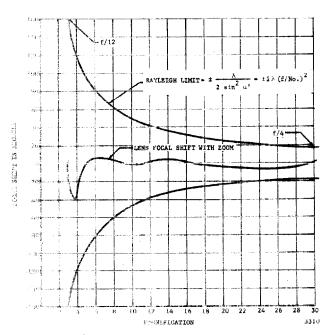
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If the system, however, were to be used with film having 50 percent transmission, some 16 times less source brightness would be required. Then either a slower projection lens or a tungsten filament lamp, or both would be feasible. Note of course, that a tungsten filament will not operate with reasonable life at the desired 3400°K minimum color temperature.





PERMITTED FOCAL SHIFT BASED ON $\frac{\lambda}{4}$ RAYLEIGH CRITERIA



(MAGE SHIFT VS MAGNIFICATION SETTING FOR 3-30X VARIABLE PROJECTION LENS

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	FOCUS AND ITS CONTROL	
	The advanced rear projection viewer requirements for excellent resolution and high magnification both necessitate careful control of the focal plane. The Rayleigh criteria determines the permissible focal range. It states that an image is sensibly perfect if the optical path of each ray is the	
-	same to within one-quarter wavelength of light. Since the f/number of the projection lens will vary with magnification, the allowable focal shift is a function of magnification. The figure at the top of the facing page graphs this relationship. It shows that at 70 power magnification only 9 microns is permissible while at 3 power, 5 millimeters can be tolerated.	
Г	Focal shift arises from two sources: vibration in the film plane due to physical movements and change in the lens object conjugate position as magnification varies. holds solution to both. ILLE	EGIB
	approach to the problem of maintaining the film's mechanical location is to restrict its movement by glass platens. At high magnifications it will be unnecessary to move the film at high rates since the image appears to move M times as fast as the film. During the movement at high magnifications, the glass plates will be closely spaced to restrain the critical film plane location. At lower magnifications, the amount of allowable focal shift is larger and the spacing between the plates may be made larger. The larger spacing will permit the more rapid transport of the film compatible with the lower magnification. All spacing is automatic	
	The problem of maintaining optical conjugate for the lens has been solved by lens designers and this solution is demonstrated in the figure at the bottom of the facing page. The 3x to 30x zoom system was designed so that the optical focal shift produced by the lens is less than the Rayleigh limit and since the lens is optically compensated, there is no mechanical focus error nor can wear in mechanical parts cause focus errors. Note that in an autofocus system, very close mechanical tolerances must be held on cams and linkages to accomplish this effect.	
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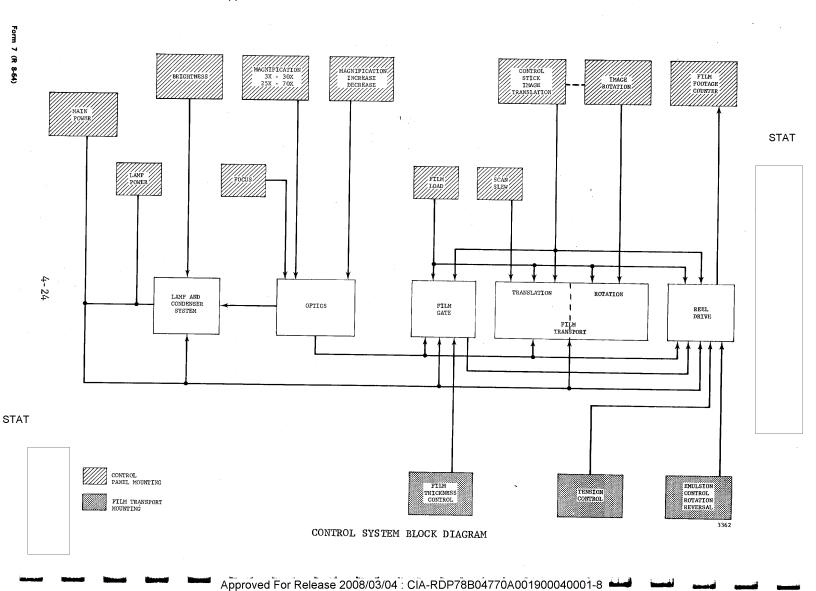
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DISTORTION	
In the computation of fast optical systems, the designer has only a few degrees of freedom. In general, resolution and distortion must be traded off; both cannot be simultaneously optimized. has chosen to favor resolution as the paramount factor and hence the design objective for distortion has been made two percent. The discussion which follows concludes that no serious disadvantage results from this necessary design choice.	STAT
The aerial camera lens is designed under the same constraints which govern the viewer's projection lens. The typical high resolution camera lens permits several percent distortion while a geodedic lens has very low resolution. Thus the imagery projected by the advanced rear projection viewer will be either high in resolution or low in distortion but not both.	
Distortion is most noticeable in imagery containing long straight lines. It is rare in nature to find rectilinear objects subtending the entire field, but when they occur, it is experience that several percent distortion can be present before it becomes detectable. Even then, recognition of the object is unimpaired. If mensuration of the image is the objective, then it is first necessary to know the exact magnification. The design objectives for the advanced rear projection viewer do not require this feature.	STAT
has developed a film projection system completely capable of performing mensuration to 0.1 percent accuracy. It is insensitive to magnification and distortion errors because it measures the film motion necessary to position successive points in the image under a cross line at the optical axis of the screen. Since measurement is always made at the optical axis, distortion does not affect the measurement. Similarly, since the accuracy of movement at the film plane is always the same, the ability to make a setting will be enhanced by increased magnification, but magnification setting need not be known accurately. This mensuration system is compatible with the advanced rear projection viewer and can be supplied if desired.	

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		CONTROL SUBS	YSTEM		

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CONTROLS -- GENERAL DESCRIPTION

The controls of the advanced rear projection viewer are shown in the block diagram on the facing page. They have been divided into two groups to provide the operator with the simplest operation consistent with the flexibility the viewer requires. All are readily accessible and arranged to indicate their normal sequence of operation. Not indicated in the figure are the protective, safety, and sequencing features; these are explained in the detailed description of each control function. figure does show those factors with which the operator will normally be concerned. The first group of controls is located within the viewer, on the film transport. They are concerned with the physical characteristics of film to be viewed. The Tension Control adjusts the tension appropriate for the film width by setting a bias voltage on the reel drive motors. The Thickness Control modifies the film gate separation for film thickness by setting a bias voltage on the film gate servo. The Emulsion Control selects the direction of rotation of each reel motor to permit rewinding of film with emulsion "in." These controls are set at the time the film is loaded and require no further change until the film reels are replaced. The second group of controls and indicators is located on the control panel. These are concerned with the functional operation of the viewer and are described in detail in the following pages.

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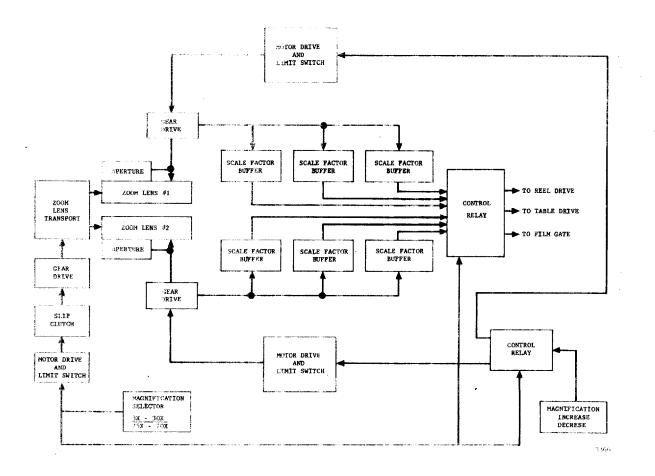
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MAGNIFICATION DRIVE AND CONTROL

Magnification control is diagrammed in the figure below. Two zoom lenses cover the ranges from 3x to 30x and 25x to 70x, and each is continuously variable between its limits. Selection of the zoom lens is by a switch on the control panel which actuates a reversible, constant speed motor drive to position the selected zoom lens on the optical axis of the viewer. Variation of magnification within the selected range is accomplished with a reversible, constant speed motor drive also controlled by a switch on the control panel. Establishing the desired magnification, mechanically sets the required aperture, and determines the film gate opening and the sensitivity of the film motion controls. Limit stops restrict the travel on the active lens. Motor speed is adjusted to double or halve the image size in four seconds.

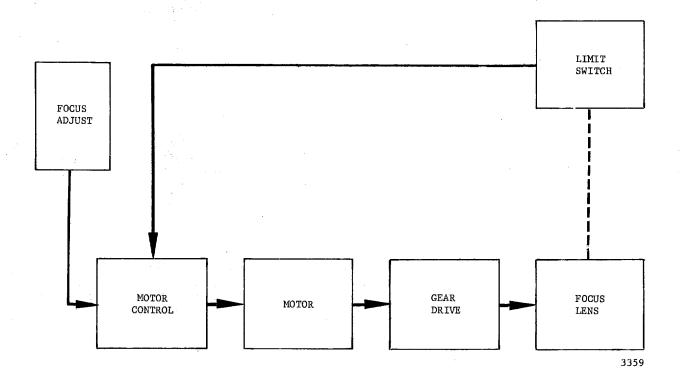
Magnification control could be associated with the control stick. However, at higher powers, any inadvertent motion of the stick will noticeably move the image. For this reason, a separate panel mounted control is recommended.



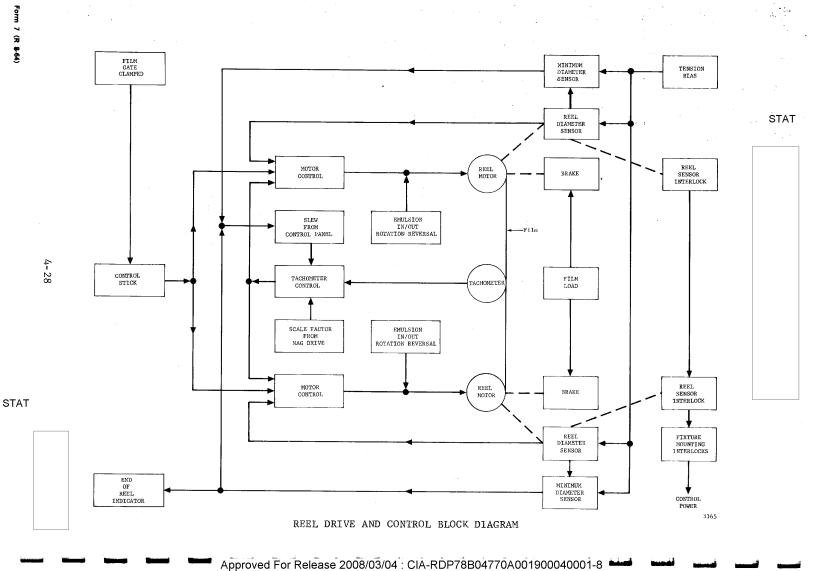
MAGNIFICATION DRIVE AND CONTROL

FOCUS DRIVE AND CONTROL

A reversible, constant speed drive actuated from the control panel focuses the lens for the type of film base and emulsion location. Limit switches are positioned to inhibit over travel of the lens. The simple block diagram of the circuit is presented below.



FOCUS DRIVE AND CONTROL BLOCK DIAGRAM



REEL DRIVE AND CONTROL

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A variable speed drive provides image motion parallel to the length of the film. It moves the film in either direction along its length to position any selected portion on the optical axis of the viewer. In the scan mode, the drive speed is scaled to the magnification so that the rate or apparent motion of the image is independent of the magnification. The reel motors are dc torque motors and are directly coupled to the film reel. As shown in the facing block diagram, three signals are summed at the motor control: One from the control stick determines the direction and magnitude of the drive system. The second from a reel diameter sensor establishes the tension on the film; and feedback within the motor control compares the armature current of the torque motor to the command signal. To provide for the various film widths a tension bias control is also provided. The third signal is an output from the film tachometer to provide the film speed reference.

All image viewing is done in the scan mode. The slew mode is selected by actuating a switch on the control panel and increases the speed of the reel drive motors, providing a minimum amount of film is on the reel. The speed is still under command of the control stick. Maximum deflection of the control stick is the wind/rewind condition. Establishing a film load condition sets the brakes on the reel motors. Additional interlocks are provided to ensure that the reel sensors and the securing mountings have been positioned before the reel drive can be actuated. Reel drive motion is inhibited when the film gate is clamped.

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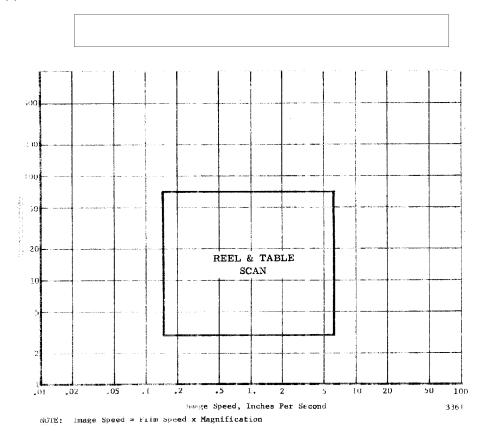
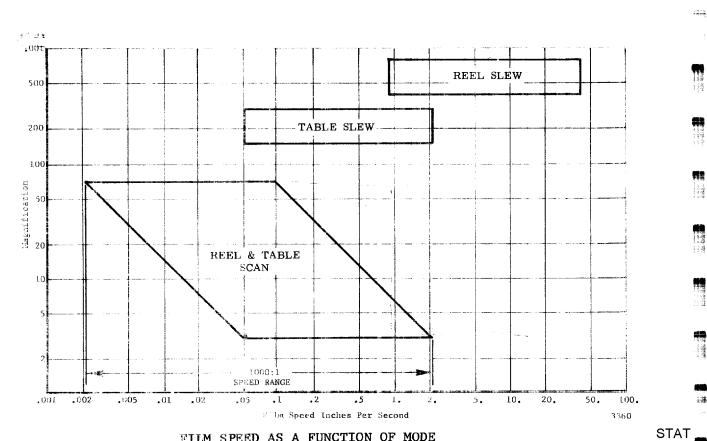


IMAGE SPEED AS A FUNCTION OF MAGNIFICATION



FILM SPEED AS A FUNCTION OF MODE

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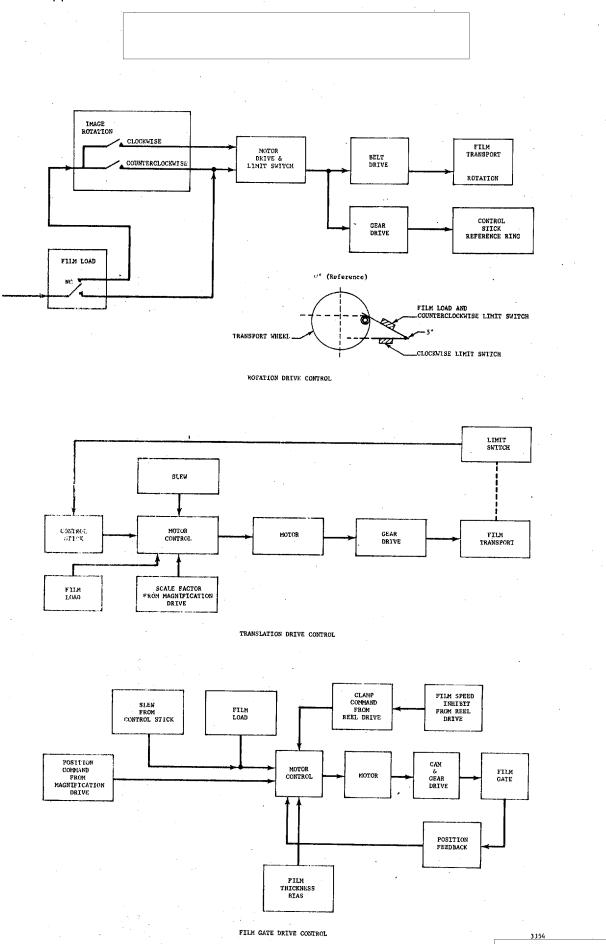
FILM TRANSPORT CONTROLS

In the scan mode, when film is being viewed, the magnification can be varied from: M = 3x to M = 70x. This is a ratio of 23:1. It is required that the film positioning rate when in the scan mode be coordinated in the x and y direction; that is the reel drive and the film table drive are to have the same motion. The controlling device becomes the motor used for the table drive. Selecting a motor capable of a 1000:1 range, permits a ratio of 43:1 to be set as the speed variation for a given magnification. Selecting as the desired minimum image speed, at the viewing screen, a rate of 0.15"/sec establishes the maximum rate as 6.4"/sec. (There should be some additional range at the low end, but it is unpredictable.) Using these values results in the figure at the top of the facing page.

In the slew mode, when film is not being viewed, magnification is of no concern. It is known that for an image rate greater than 6"/sec no interpretation can be obtained. To simplify the design and stay within the mechanics of the viewer the slew mode programs the table drive to the M=3x condition. The reel drive however is programmed so that a rate sufficient for 40'/sec of film is the maximum. This is shown in the figure at the bottom of the facing page.

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ROTATION DRIVE AND CONTROL

A reversible constant speed motor drive provides image rotation as shown in the figure at the top of the facing page. Controls permit the selection of clockwise and counterclockwise modes. The rotation is restricted to \pm 180 degrees by limit stops. This eliminates the necessity of using sliprings for maintaining the electrical continuity of the components mounted on the film transport while providing a total rotation angle of 360 degrees. For the "Film Load" condition an override is provided to position the transport parallel to the access door. The motor drive will provide an image speed at the screen of 36 degrees per second. The rotation angle of the film transport is transmitted to, and mechanically positions the panel control stick. This maintains the correlation of image motion, as viewed on the screen, with the control stick manipulation.

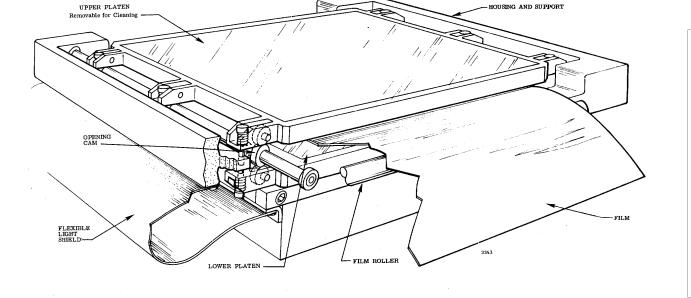
TRANSLATION DRIVE AND CONTROL

A reversible, variable speed drive provides image motion perpendicular to that of the reel drive as shown in the diagram in the center of the facing page. It provides the means to move the film in either direction across its width to allow positioning of any portion on the optical axis of the viewer. The speed of the table is scaled to the selected magnification so that the rate, or apparent correction control of the image is independent of the magnification. Limit switches restrict the travel of the table. The table is automatically positioned to its maximum forward position for film load. Actuation of the slew command disables the magnification scaling and activates the maximum rate of the 3 power magnification.

FILM GATE DRIVE AND CONTROL

The film gate control is shown at the bottom of the facing page. It is a position servo which, in the scan mode, obtains its command from the magnification setting, and with the set film thickness bias, establishes the gate separation. Two override conditions are provided: in the slew and film load modes, the gate is programmed full open; when there is no reel drive, the gate will be closed.

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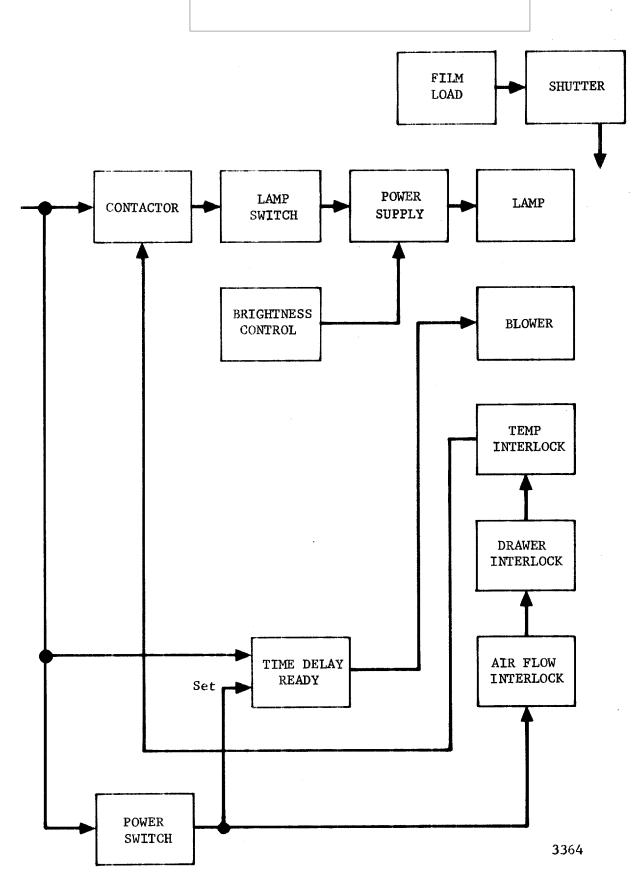
FILM GATE ASSEMBLY

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FILM GATE

The film gate is the device that holds the photo imagery precisely in the focal plane for projection. As the magnification power increases, the depth of the plane of sharp focus is reduced, until at 70x it has practically no permissible variation. Also, as the magnification is increased, the speed at which imagery can be moved through the film projection gate is reduced if the observer is to obtain information from the projected image. Thus, it is practical to move film at lower speeds through a gate opening of reduced size.

In the viewer, this basic factor is utilized in the design of the film projection gate. The gate consists of a sturdy housing supporting two optical quality glass flats which are guided and positioned by a gear and cam shaft mechanism. The moving film only contacts smooth rollers to avoid abrasion. In the scanning mode the operation of the gate is slaved to the film speed in a pre-established program. Thus, the film and the glass flats are protected from damage by excess film speed while the plane of the film is held to a dimension within the capabilities of the projection lens to focus at the magnification appropriate to the selected film speed. The glass flats are readily removable for cleaning or replacement and will require no special alignment techniques for reassembly.



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ILLUMINATION SYSTEM CONTROL

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A current regulated dc power supply is required by the xenon arc lamp. Its output will be from 12 to 50 amperes at 20 to 50 volts with a ripple content less than 3 percent rms. Open circuit voltage will be 100 volts. Input power will be 208 to 230 V ac, 3-phase delta. The lamp current will be controlled from the viewer console while the power supply will be located in the electrical and cooling module.

The xenon arc is automatically ignited 10 to 45 seconds after the power supply is turned on by means of a brief pulse of r-f energy at 40 to 50 kilovolts. This pulse ionizes the xenon gas and sustains conduction until the arc heats the electrodes and the gas and becomes self-sustaining. Interlocks prevent activation of the igniter circuit unless the power supply is turned on. Filters prevent voltage feedback from the r-f ignition pulse into the power supply.

A blower is provided to cool the lamp and its associated optics and a time delay provides for the maintaining of the blower on removal of the lamp power. An air-flow type interlock prohibits application of the lamp power unless the cooling blower is on. A temperature interlock prevents over-heating of the illumination system and a drawer interlock prevents removal of the lamp with power on. Actuation of an interlock produces the same action as a power turn off. For film load the lamp power remains on and a shutter is closed blanking the light beam external to the lamp compartment. The block diagram on the facing page relates these features.

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REAR PROJECTION VIEWER STRUCTURAL FRAME

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STRUCTURE AND ENCLOSURE

The structure of the advanced rear projection viewer will be of the "space frame" type, incorporating all of the primary support and alignment functions into the one-piece unit. This will achieve the necessary high overall stiffness while maintaining a practical weight.

The structure will be fabricated as a heat treated, normalized aluminum alloy weldment. The individual members will be selected from standard structural sections according to their functional need. The assembly is illustrated in the figure on the facing page. The functions of the structure are as follows:

- Support of the optical system in rigid alignment
- Support of the controls and their panel
- Support of the enclosure panels
- Position and align the vibration isolation mounts, jacks, and caster wheels.

The viewer enclosure will be designed to protect the mechanism and optics from the operational environment. The enclosure will be a series of fixed and removable skin panels. Where removable, the panels will be seated on resilient foam elastomer pads which form a dust seal. This, in conjunction with a slight internal pressure, will maintain a clean interior. Attention will be given to all panels to preclude any drumming and attenuate sound transmission from the interior of the viewer. All areas of the viewer needing access for maintenance will be provided with doors or removable parts scaled to the operation which necessitates the access. Film loading and normal transport maintenance will be achieved through the front door of the cabinet.

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SECTION 5		
MAINTAINABILITY AND RELIABILIT	YY .	

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MAINTAINABILITY AND RELIABILITY

The Advanced Rear Projection Viewer system is designed, when considered in combination with operational and logistic factors, so that an optimum balance is achieved between inherent availability and maintenance downtime.

Particular attention is paid to the following basic maintainability principles in the design of the viewer system.

- Minimum number and complexity of maintenance tasks (i.e., calibration, adjustments, inspections, etc) by maximum use of simple design which includes optimum interchangeability and use of standardized equipment
- Rapid and positive recognition of equipment malfunction or marginal performance
- Rapid and positive identification of the replaceable defective part, assembly, or component
- Minimum personnel skills and training requirements to develop adequate maintenance proficiency
- Minimum numbers and types of tools and test equipment (special and standard) required to perform maintenance
- Optimum access to all units and components requiring maintenance, inspections, removal or replacement
- Maximum safety for both equipment and personnel involved in the performance of maintenance.

Examination of the concept layouts will show that all routine maintenance and servicing may be accomplished from the front. The large size of access doors, coupled with the fact that the film transports may be rotated ± 180 degrees and that the viewing screen can be swung open, makes every major element readily accessible.

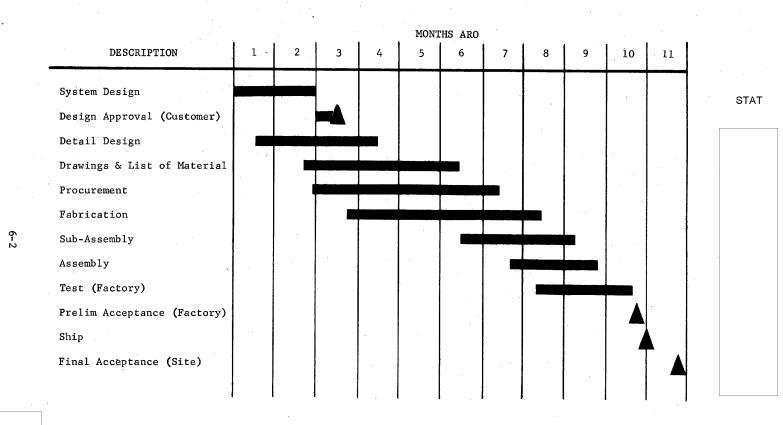
Dust-tight door seals and filters on the ventilating blowers will reduce the need for frequent cleaning, if the system is kept closed. Judicious use of electrical disconnects will permit the isolation and removal of electrical components for test and/or repair. Working clearances inside the system and on the electronic chassis are generous.

Clear identification of circuits with accurate service diagrams and schematics will expedite troubleshooting.

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·	STATEMENT OF			HEDULE		
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ENGINEERING PROGRAM SCHEDULE

		STATEMENT OF WORK
fab: Sec	rica: tion:	proposes to furnish all y labor, material, and facilities required to design, develop, e, assemble, and test one Rear Projection Viewer as described in 3 and 4 of this document. The work will be performed in accordance the schedule shown on the facing page.
Des	crip	ion of Tasks
A.	Pro	ect Engineering
	time	orm all technical and administrative functions required for the ly performance of the contract. Coordinate internal departmental vities and conduct all necessary customer liaison.
В.	Syst	em Design
	1.	Finalize System Configuration - Determine final power requirements, neat dissipation, spatial allocation.
	2.	Preliminary System Performance Specification - Prepare specification setting forth system and subsystem performance and test requirements
	3.	Major Purchased Component Definition - Define and develop specification control drawings for major procured items and long-lead components.
	4.	Preliminary System Test Plan - Prepare plan setting forth system and subsystem functional test criteria.

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C. <u>Design Approval</u>

В.

Submit system engineering drawings for customer approval.

D. <u>Detail Design</u>

- 1. Low range zoom lens
- High range zoom lens
- 3. Lens carriage
- 4. Main frame
- 5. No. 1 mirror and support
- 6. No. 2 mirror and support
- 7. Film gate control modification
- 8. Condenser lens
- Condenser housing and lamp mounting
- 10. Film transport
- 11. Cooling and electrical module.

E. Procurement

Materiel shall procure all major components, raw material, hardware, glass, and outside services. Procurement shall be based on released drawings, purchase requisitions, or advanced material requests. .

F. Fabrication

The model shop shall be responsible for:

- 1. Ordering of all raw material and hardware based on released drawings.
- Planning as required and routing of parts through various stages of fabrication and processing.
- Control of parts during fabrication and inventory of parts prior to assembly.

Engineering shall be responsible for technical liaison and material review during fabrication.

G. Assembly

- 1. The Model shop shall be responsible for subassembly, final assembly, and alignment.
- 2. Engineering shall provide technical liaison during assembly to define and interpret subassembly, final assembly, and alignment requirements.

H. Quality Control

Shall provide receiving inspection, surveillance inspection during fabrication and assembly. Quality assurance criteria shall be best commercial practice.

I. Test

All tests shall be conducted under the supervision of engineering. The model shop shall assist as required during engineering tests.

J. Preliminary Acceptance

Shall be performed by Engineering with the assistance of Quality Control personnel. Demonstrations shall be witnessed by cognizant Government Personnel. Acceptance shall be based on the Test Plan developed under section B4, meeting the performance specification developed under B2, and conformance with the standards of good commercial workmanship.

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K.	Final Acceptance	
	Shall be at the customer's facility. Engineering shall provide technical support during final acceptance.	
L.	Maintenance and Operation Manuals	
	 Engineering will prepare an operational manual for the Rear Projection Viewer. This document will clearly describe each function and will be complete with all necessary schematics and drawings. Recommended operation procedure will be called out. 	
	 Engineering will prepare a maintenance manual for the Rear Projection Viewer. This document will define troubleshooting, maintenance, and cleaning operations. 	
Μ.	<u>Trave1</u>	
	Engineering shall visit the customer's facility for the purpose of technical discussions and review of technical progress. It is anticipated that four man trips to the Washington D.C. area, with an average duration of one week including travel will be required.	
De1	iverable Items	
	proposes to deliver the following:	
Α.	One Rear Projection Viewer in accordance with Sections 3 and 4 of this document.	
В.	Spare Parts	
	 Four (4) projection lamps Two (2) platen assemblies One (1) can of touch-up paint. 	
C.	Documentation	
	1. Operation Manual 2. Maintenance Manual	

Delivery Point

C.

All deliverable items will be shipped f.o.b.

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3. Recommended 6-month operating spare parts list.

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SECTION 7	
ODCANTZATION MANACEMENT AND	
ORGANIZATION, MANAGEMENT AND CAPABILITY OF PERSONNEL	
Topics	
Rear Projection Viewer	
Project Management	
Project Organization Project Engineer	
Personnel Resumes	



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PROGRAM MANAGEMENT, ORGANIZATION, AND PERSONNEL RESUMES	
organizational structure reflects its current capabilities in research, development, and production technologies spanning sales in 15 major component and weapon system product categories and involving several times that many specific technical program applications. The corporation is organized as a family of divisions and subsidiaries, each with an extensive capability in its assigned product areas and their related technologies. Each division or subsidiary is headed by a corporate officer reporting to the office of the President. Each division operates	
autonomously; however, each is backed by the Illiancial strength of the total corporation.	
will be responsible for conducting the Advanced Rear Projection Viewer Project.	
Manager, who is also a corporate officer. Under management, departments have performed research, development, and production on many major electronic, opto-mechanical, electro-optical, and electo-mechanical systems programs. Among these are the Skybolt missile guidance system, Ranger and Mariner control and sensor systems, Datico automatic checkout equipment for Polaris submarines, navigation and information systems for a broad range of programs, and precision optical systems for all military services.	STAT
The policy of decentralization has also been applied to the operating organizations which make up the A department is completely integrated with the resources and facilities to operate independently of the other corporate organizations, at the same time having available to it the full support and backing of the corporate organization. Each department is directed by a Vice President and Manager, the operating line executive within the division, responsible to the Division Vice President and General Manager.	STAT
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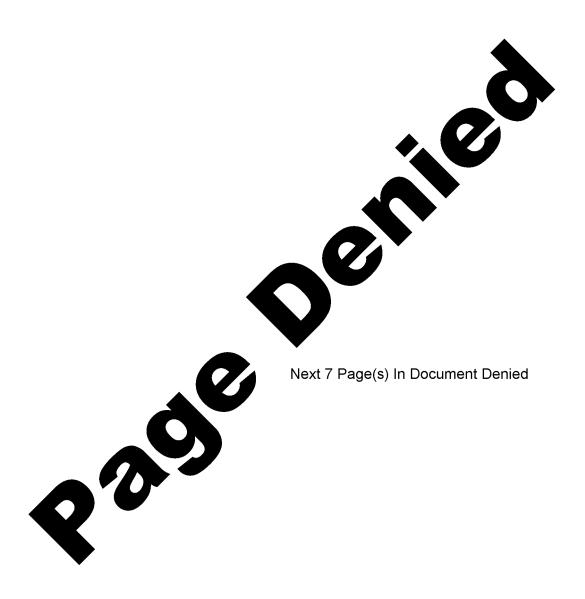
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А	Approved For Release 2008/03/04 : CIA-RDP78B04770A001900040001	-8
Rear	Projection Viewer Project Management	
	ject Organization	
110,0	Jeec organization	
inclu	will be responsible for the and direction of the Advanced Rear Projection Viewer Projectiong the design, development, fabrication, test, and delivitems specified in the statement of work.	ct.
will and p	Vice President and Manager of the Technical De be responsible for the overall management of the design, deproduction.	epartment, evelopment,
	w	ill monitor
of pr	program for all necessary resources and will conduct manager progress.	ment review
from Track to di tion the p	order to apply maximum management and technical experience do similar programs, the project will be accomplished within the king and Display Systems Group. A Project Engineer will be direct the project effort and be responsible for the proper at of all necessary resources, facilities, and personnel. He point of contact for the customer progress reporting, and fact team members in the exchange of technical information.	the appointed applica- will be
Proje	ect Engineer	
The P	Project Engineer's responsibilities will include the follow tions:	ing
• Sep	Serve as the point of contact with the customer in the exchaproject information.	ange of
• D	Direct all aspects of the program including preliminary desidevelopment, final design, assembly, testing, and support acceptable.	ign, ctivities.
• D	Develop and authorize detailed program plans and schedules, order to support the performance of the program effort.	in
• M	Monitor technical, schedule, and cost performance to ensure pliance with program objectives.	com-
• Re	Review and direct the implementation of customer specificative requirements, including approved program changes.	ions and



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SECTION 8

RELATED EXPERIENCE

Topics

Viewing and Display Equipment

Photo Interpretation Viewing and Intelligence
Data Processing Systems

Optical Systems and Equipment

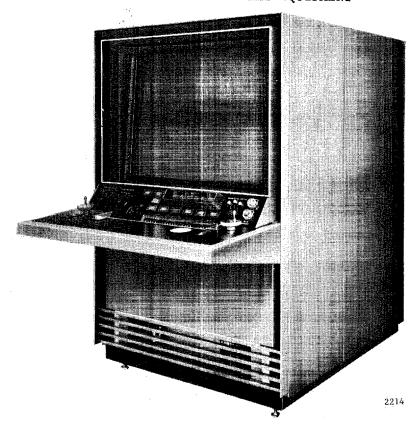
Airborne Optical and Tracking Systems and Equipment

Optical Design

Digital Computer Programs

Vigicon Command and Control Display Systems

VIEWING AND DISPLAY EQUIPMENT

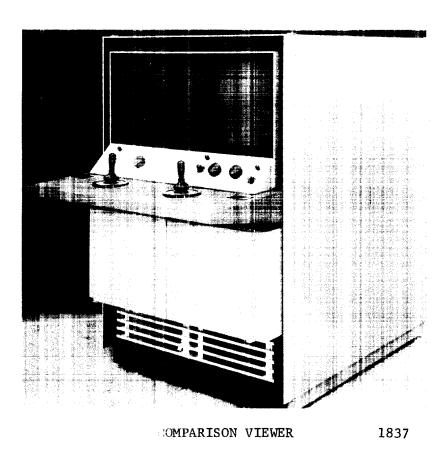


REAR PROJECTION PANORAMIC VIEWER

Rear Projection Panoramic Viewer

The Rear Projection Panoramic Viewer can automatically compute true ground distance from aerial film taken with a panoramic (horizon-to-horizon) camera. It is contained in a console with the projection screen extending above the desk-type control panel. Its design gives the operator a clear view of the screen plus easy access to controls. The Viewer consists of the optical system with viewing screen, the film support and transport mechanism, the measuring system plus computer, and operating controls.

The film mechanism utilizes power-driven spools for advancing, rewinding, and scanning the film. During scanning, the film speed is controlled by the operator. Ground distances up to 1,000,000 feet and accurate to within 1 percent, can be measured between two points on the film. The spool capacity accommodates film from 100 to 1,000 feet. The illumination system is designed for use in a normally lighted room.



Comparison Viewer

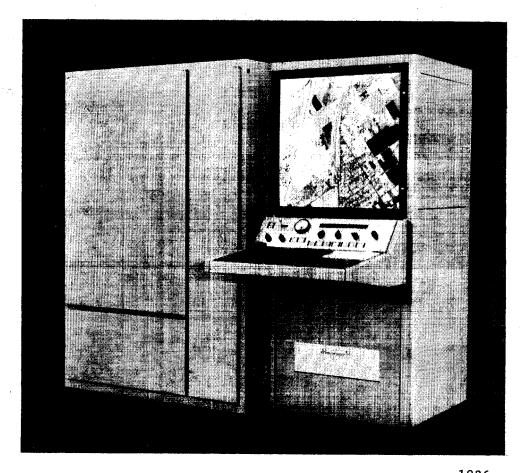
The comparison viewer, PPS-MI, was developed for the U.S. Navy Bureau of Weapons. This device is used in comparative analysis of photographic, air reconnaissance records.

Images may be projected from two different rools of film onto adjacent screens for comparative analysis, or images from adjacent frames on a single roll may be projected onto the right-hand screen for stereo viewing. During comparative analysis, provision for 360-degree image rotation and magnification of each image up to 20 times facilitates examination of records, regardless of record scale and orientation. To aid in stereoscopic inspection, provision is made for the correction of up to ± 7.5 degrees of crab between stereo images.

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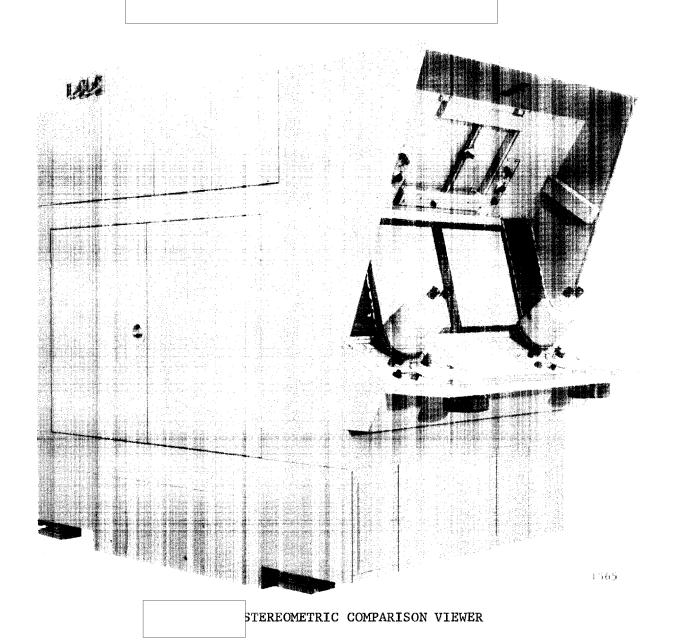
Rear Projection Viewer with Computer, PC-2 and PC-2A

The PC-2 viewer with computer is used to facilitate the interpretation of aerial photography. It is the prototype for the P/C-M2 viewer.



The Rear-Projection Viewer with Computer is used to facilitate interpretation of aerial photography. The viewer projects any 2.15 by 2.25-inch portion of a 70-mm, 5- or 9.5-inch transparency at 10 times magnification onto a rear-projection viewing screen. The operator can control the image scanning speed, positioning, and brightness. The image can be rotated to one of two positions 180 degrees apart. This feature permits placing either panoramic horizon upright. The PC-2A has ± 90 image rotation, in addition to ± 180, to accommodate oblique photography.

A computer is incorporated as a removable viewer module. It is programmed to solve for true ground distance between measured points on vertical, oblique, panoramic photography and SLAR recordings. The computed distance is displayed on a control panel. The ground distance output also can be moved easily from one viewer to another, providing cost savings in a multiviewer installation.



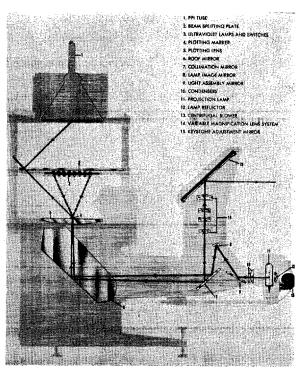
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Stereometric Comparison Viewer

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has designed, developed, and manufactured a wide variety of viewing systems and equipment. Typical of these is the Stereometric Comparison Viewer (SCV), produced under . The SCV is a versatile aerial photography interpretation instrument consisting of two similar, integrated viewing systems which can be used for rear projection comparison viewing of similar photos, and for direct stereo viewing, computer mensuration, data block readout, and aircraft flight path display.

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SKY SCREEN WITH OPTICS

Sky Screen

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A lightweight and compact optical projector, Sky Screen was designed, developed, and produced for use by the USAF for displaying radar track information.

In operation, the 16-inch PPI scope image is reflected from the beam-splitter plate to the operator, while an ultraviolet illuminated marker on the plotting lens is seen through the beamsplitter plate. Thus, when superimposed on the radar pip, the marker indicates the exact location of the radar track.

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PHOTO INTERPRETATION VIEWING AND INTELLIGENCE DATA PROCESSING SYSTEMS

AN/MSQ-59 (TIIF) Study Program

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selected from a highly competitive field, was awarded

by the Army for a major study program

concerning the AN/MSQ-59 Tactical Imagery Interpretation Facility (TIFF).

Under this 19-month contract, is studying the problem of providing automation which can markedly increase the efficiency of the person who examines, evaluates, and collates information collected by photo
reconnaissance aircraft and the intelligence subsystem of the Army
Command and Control Information System.



TACTICAL RECONNAISSANCE INTERPRETATION PROCESSING SYSTEM

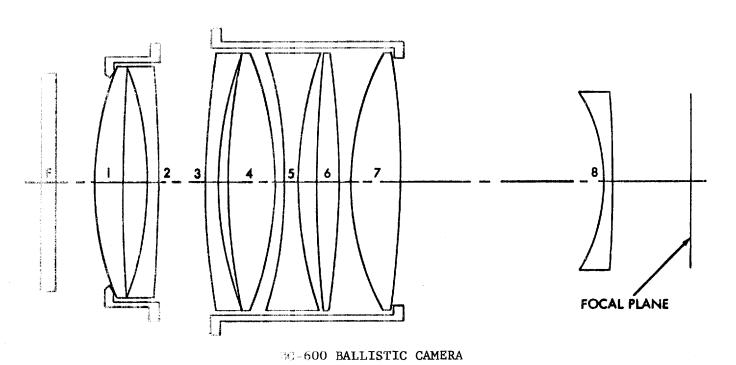
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Mapping :	from Radarscope Presentation
requirements ide-look studies requirements	conducted studies from 1957 to 1960, under Contracts to the U.S. Army Engineering Research lopment Laboratories, to investigate equipment and procedural ents for mapping from Photo Processing Interpretation (PPI) or king radar presentations and airborne guidance data. These were made to establish airborne systems and data reduction ents to utilize radar presentations for producing planimetric target positions.
Standard	Electromechanical Viewer Modules
and the adevelopment contracts film trans	developed a set of standard modularized film viewer assemaid in the conduct of studies, development of viewing systems advance effort related to the preparation of proposals. This ent reflects experience and knowledge gained as a result of pas and related studies and is a continuing effort. A standard insport, an Air Film Gate, a Joystick, Condenser Assembly and e are available for study and development.

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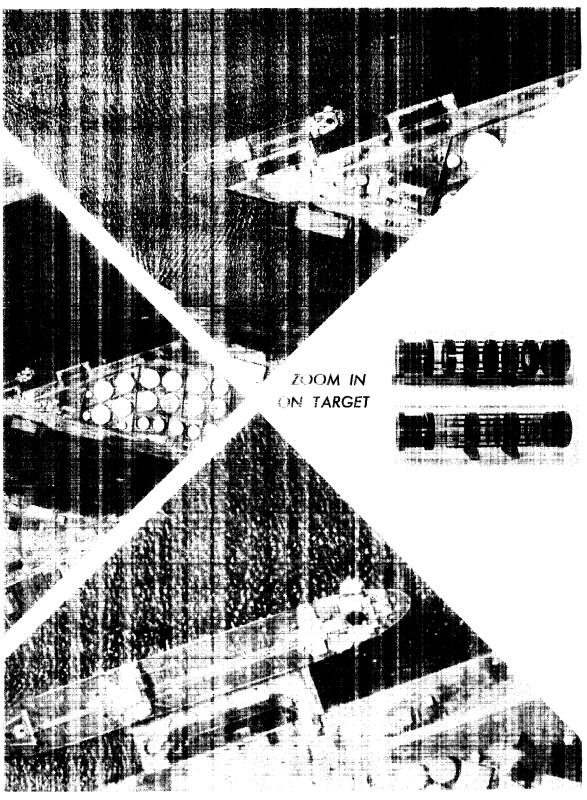
OPTICAL SYSTEMS AND EQUIPMENT allistic Camera System Ballistic Camera System, designated BC-600, was developed or the Air Force under Contract It is currently being sad at Cape Kennedy and the Atlantic Missile Range (AMR) to gather presision optical data on missile and aircraft tests. The camera system is esigned so that data reduced from the photographic plates will be accurte to 1 second of arc. To accomplish this precision, the optical axis of the camera is maintained to within 1/2 second of arc with respect to he focal plane for any orientation of the camera. Be BC-600 contains a refractive photographic objective lens system of ight air-spaced elements having a 600-mm focal length, a 12-inch dimeter clear aperture, and a 24-degree field of view. The BC-600 is sed to photograph objects which are point sources of light at practically infinite distances; therefore, the focal plane is set for the best focus of objects at infinity. Polysonic wind tunnel to performance specifications, is the only successfully operating system of its type in the ation. It is used to obtain precision photographs of the boundary layer and shock waves associated with wind tunnel tests of missiles and airraft. The design and construction of the Schlieren system involved: Analysis of performance specifications to determine design requirements System design Fabrication, assembly, and testing at the facility in Disassembly, shipment reassembly at the formance tc specifications. Insonic wind tunnel, and proof of system performance tc specifications. Resystem is sharp-focusing over a range of 1 foot from the center of the test section span and is designed to see through the perforated walls of the transonic section of the wind tunnel. The field of view at the minel centerline is 18 inches in diameter and is free of vignetting.			
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	THE CENTER !!	ine 15 to inches in diameter and 15 free or vignetting.	

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ZOOM LENS SYSTEM

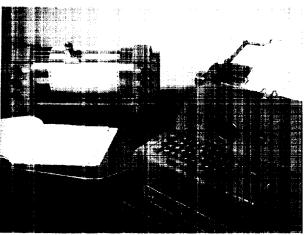
2003

Zoom Lens System	
Under an independent R&D program, has designed and developed an optically compensated, high-quality lens system which produces continuously variable magnification within limited physical space. The Zo Lens is particularly adaptable for use as a projection lens for a varie of space and military applications where high quality, continuously variable magnification is a requirement.	om t v
To demonstrate the feasibility of the design approach, has designed and built a prototype projection lens based on the variable magnification lens system. A positive air-spaced triplet, corrected for chromatic and high-order geometrical aberrations, is located in the object space and provides a magnification of 1.86 power. A negative ai spaced triplet, also corrected, is located in the image space and provi additional magnification of 5.1 power. The total auxiliary magnificati is 9.5 power, producing a magnification of the complete system of 3 power to 30 power.	r- des on
Under a present independent R&D program, has designed and is building a 3X to 100X zoom projection lens covering a 9 1/2-inch square format at 3X magnification.	

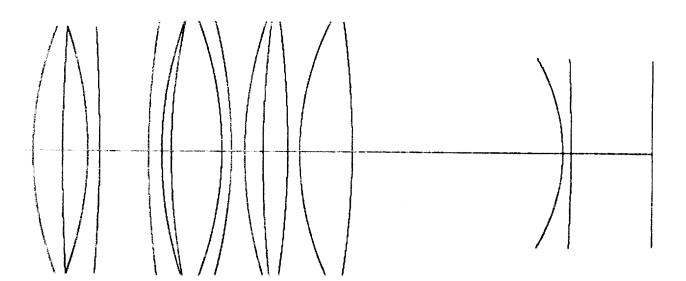
ALOTS CONFIGURATION

Approved For Release 2008/03/04 : CIA-RDP78B04770A001900040001-8	
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AIRBORNE OPTICAL AND TRACKING SYSTEMS AND EQUIPMENT	
Airborne-Lightweight Optics Tracking System (ALOTS)	
Under Contract Lightweight Optics Tracking System for AFETR, Patrick Air Force Base, Florida. The program requirement is for a precision system to provide airborne photographic coverage of missiles during early launch, passage through the high dynamic pressure regions, staging separation, and re- entry phases of flight.	
The ALOTS at present is in the final stages of acceptance, and consists of four integrated major components: a Manual Tracking Station, an Automatic Tracking System, a Photographic System, and the Control Console. It was used successfully during the GT-7 launch and separation.	
The Manual Tracking Station is a modified B-50 sighting station installed at Station 710 on top of the C-135 aircraft, utilizing a de-signed sight.	STA
The Automatic Tracking System and the Photographic System are integrated into a single mechanical assembly contained in the pod mounted external to the C-135.	
The Automatic Tracking System's two vidicon sensors provide coarse (4 by 4 degrees) and fine (40 by 40 minutes) fields of view. Error signals from the coarse field sensor servo the platform to center the target until it is acquired in the fine field sensor. The fine field is the same as that seen by the recording camera of the Photographic System.	
The Photographic System uses a 70-mm camera to provide sequential photographic coverage. Camera telescope optics consist of a 200-inch focal length, T/16 system with primary and secondary reflecting elements, a Schmidt type correcting plate placed in front of the reflecting elements, and an air-spaced doublet lens and field flattener placed in the converging beam anterior to the focal plane.	
The Control Console provides all of the monitoring and control facilities not included in the Manual Tracking Station. The video monitors on the Console display the coarse tracking field and the fine tracking field. The entire system is designed to permit easy and rapid maintenance.	





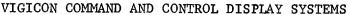
2004

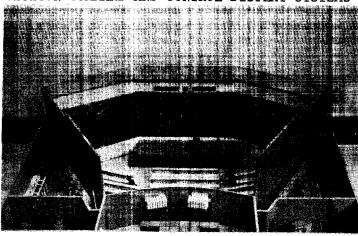


CONTROL DATA G-15D COMPUTER

Approved For Release 2008/03/04 : CIA-RDP78B04770A001900040001-8	
OPTICAL DESIGN	
Optical Design Consulting Services	
personnel are experienced in the requirements of optical systems consulting services. This experience has been gained through activities on such projects as the following:	•
Flicker Range Finder (Government Contract): This system was developed for use in the M-48 and M-60 series battle tanks. It replaced the existing beamsplitter of an M17C 2-meter range finder with a time-sharing mirror device to precisely transmit and reflect images from left and right telescopes of the system.	
Polaris Alignment Periscope (Government Subcontract): Design and consulting work was carried out on the development of an inertial platform-aligning periscope.	
Articulated Telescope (Government Contract): This instrument is a fixed-power, direct-fire telescope with selective ballistic reticles. Articulation in three places allows universality and versatility in vehicle installations.	
Ultracompact, Airborne, Telescope Gunsight (Backup for the F-106 fire control system): This instrument provides 4-power, 6-degree field, eight-operator selectable sets of stadiametric reticles with long eye relief for use with a face mask.	
ptical Design Computer	
optical design engineers utilize two electronic computers Control Data G-15D) with a special plotting attachment for making rapid ptical calculations and ray traces. Use of the computer for solving he complex mathematical and analytical problems inherent in optical esign permits considerable savings in engineering manhours.	

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	OUGITAL COMPUTER PROGRAMS	
	Ranger Central Computer and Sequencer (CC&S)	•
STAT	has performed manufacturing, test, design, study, and evaluation programs for the CC&S subsystem for the Ranger project. manufactured and provided all engineering support to the CC&S units and associated ground support equipment for the Ranger 6 through 9 firings. This involved nine CC&S subsystems, the last delivery being made in March of 1964.	STAT
	CP-720 Digital Computer for AN/USQ-28 System	•
	The AN/USQ-28 Aerial Electro-Photo Mapping System being produced for the Air Force contains the most accurate inertial reference system available for airborne use. The CP-720 digital computer used in this system is designed and manufactured by	STAT
	designed and manufactured by	SIAI

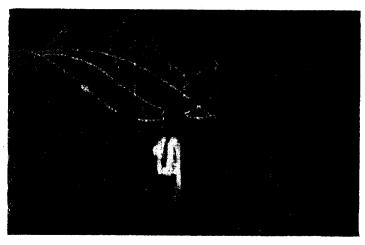




Satellite Tracking Annex Study

This study for involved the evaluation of the existing display and command-control requirements and recommendations for advanced satellite system.

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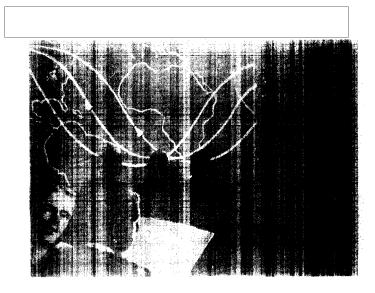


1828

Eastern Test Range (ETR) Trajectory Display

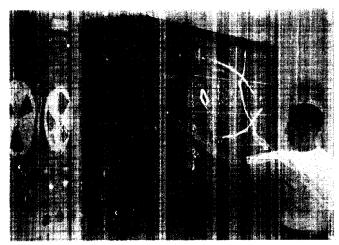
This contract provided with the Trajectory Display equipment to trace movements of missiles and/or satellites at the ETR Control Center at Cape Kennedy. The new range control center is designed to provide improved and expanded control for the various elements which comprise the ETR. It also serves as a mission control center for global tracking operations and orbital missions such as Gemini and Apollo. The system, used by the Air Force, displays dynamic movement of as many as four different space vehicle trajectories or orbital plots in a real-time sequence. This presentation is a rear-projection system utilizing an 8-by-8-foot screen. 8-17

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Gemini/Apollo Mission Analysis Display

as awarded this contract to provide the Mission Amalysis Display equipment to trace the maneuvers of Gemini and Apollo spacecraft. The display system presents dynamic movement of the space vehicle trajectories or orbital plots, as defined by complex of computers, in a real-time sequence. This presentation is a rear-projection system utilizing a 6-by-6-foot screen. It will be installed and operated at Goddard Space Flight Center.



1825

SM-2 ASW Helicopter Crew Trainer, Device 2F64A

is for four identical display systems, This contract with each to include a self-enclosed console which utilizes folded optics and mirrors to portray on a 30-by-30-inch screen the movements of the SH-2 helicopters and various targets in flight. The system is an instructor's aid in verfication and evaluation of commands to the airborne vehicles. The U. S. Naval Training Device Center display interfaces with a digital computer as the data link and is installed in a mobile trailer for operational flexibility.

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1827

Norfolk Anti-Submarine Warfare Task Force Simulator, Device 14A6

This contract award by covered the design and delivery of a forward-projection display subsystem consisting of large-screen presentations for the U. S. Navy Anti-Submarine Warfare (ASW) School at Norfolk, Virginia. This subsystem requires the conversion of the simulator's data processor digital and analog data outputs into a large, dynamic, graphic presentation, depicting the instantaneous positions of multiple tracks, along with pertinent annotations, on three 10-by-10-foot screens. The tracks are displayed in real time and in multiple colors, the latter for the purpose of distinguishing between aircraft, surface, and subsurface vessels. The efforts required in this display subsystem included system analysis, design, integration and fabrication. The design of special-purpose electronic equipment was also involved.

San Diego Anti-Submarine Warfare Task Force Simulator, Device 14A6

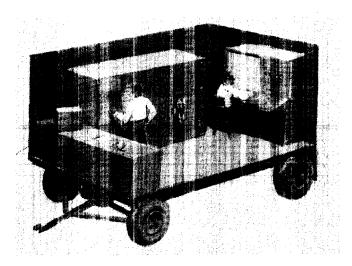
This is a follow-on contract from for a display subsystem identical to the Norfolk ASW Simulator, to be installed in the San Diego ASW School for Pacific Fleet Task Force training.

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8-19

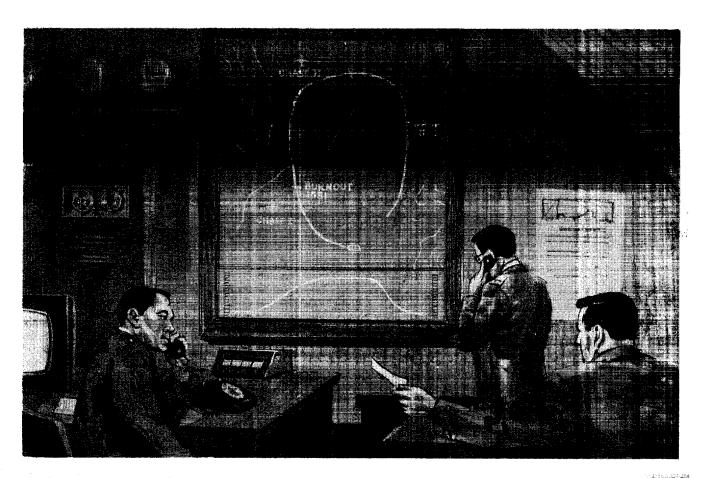


1326

Gemini/Apollo Terminal Landing System

is to provide the Terminal This contract with Landing Display Subsystem for the NASA Manned Space Flight Center, Houston, Texas. The purpose of the system is to analyze and subsequently select the optimum recovery system for Gemini/Apollo spacecraff. The display, recording and presenting the attitude, altitude and position of spacecraft during the reentry phase of the mission, will be portrayed on two 15-inch-square screens by utilizing mirrors to told the optics. The system, as installed in a trailer/van, is air transportable and ground mobile.

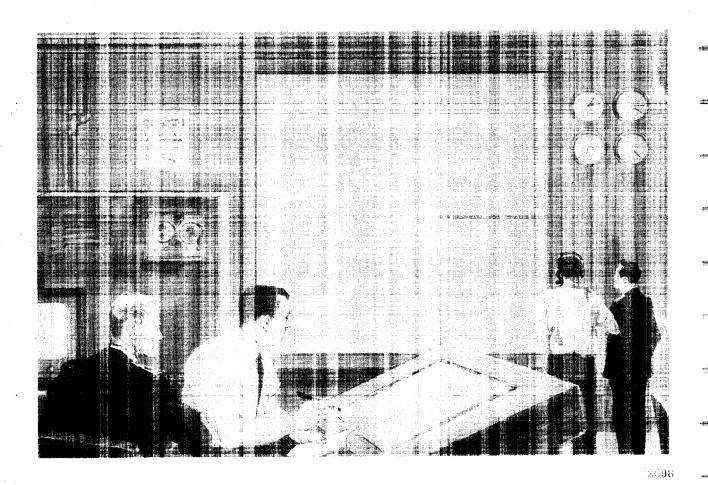
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2599

X-15 Flight Monitor Display

Developed for the NASA Flight Research Center, Edwards AFB, California, the various mission modes of the X-15 experimental flights are permanently recorded on this multicolor, rear projection, large screen display. Colored traces, each depicting a phase of the operation, are generated in real time to present the path of the X-15 during takeoff under the B-52, drop and trajectory, and burnout descent. The instantaneous positions of the "chase" planes with respect to the prime vehicle are also displayed on the 4 x 5 ft "split" screen, altitude being recorded on the lower 1/5 of the screen. Reference background and symbology capability are additional features of this operational type system.



AUTEC Principal Real Time Display

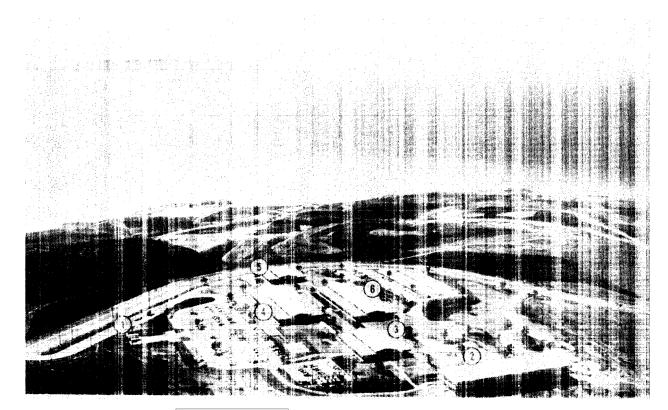
This system is being developed for U.S. Navy Underwater Ordance Laboratory, St. Andros, Bahama Islands. Missiles and weapons testing both above and below the sea are displayed on a large, theater type screen at the control center for the U.S. Navy's first underwater test range in the Bahamas. The display will develop a real time presentation to provide observers with immediate information on all range activities. The dynamic movements of all submarines, ships, aircraft, underwater weapons and missiles are recorded on a 10 x 10 ft "split" screen. The dual display allows for coincident comparison of graphic targeting against profile display of altitude and depth data.

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	SECTION 9	
	FACILITIES AND EQUIPMENT	
	Topics	
	Electronic Laboratories	
	Electronic Assembly Area stromagnetic Interference Test Laboratory bration Certification of Test Equipment	
	Development Machine Shop	
	Metrology Laboratory	
Opt	cal Laboratory and Fabrication Facilities	
	Photometric Standards Laboratory	
	Data Reduction Center	
	Technical Information Centers	

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RESEARCH PARK FACILITY

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	SECTION 9
	FACILITIES AND EQUIPMENT
O	ccupies 5,220,420 square feet of building space, of which 4,043,217 are wned by the corporation. The occupies 1,164,205
S	quare feet, of which 555,000 square feet are allocated to the
T	he proposed Advanced Rear Projection Viewer Project will be conducted
W	ithin the This
bi tl oi o: f: cc	ultimillion-dollar R&D facility, activated in 1962, consists of six uildings occupying 120,000 square feet on a landscaped campus overlooking he Pacific Ocean. One of the buildings houses a fully equipped celestial bservatory. Others contain research and testing laboratories, engineering ffices, electronic assembly areas, a precision machine shop, computer acilities, publication and reproduction areas, a technical information enter, and the division executive offices. This
Re	he pictures on the facing page show aerial and ground-level views of the esearch Park R&D Center. The facilities and equipment pertinent to the roposed program are described in the following paragraphs.
W:	
ar pr	he design, development, and engineering personnel assigned to the project ill be located in the 30,000-square-foot, air-conditioned Building No. 6 t Research Park, where drafting facilities, and electronic laboratories re close at hand. Other engineering support laboratories include the recision optical laboratories and the environmental test laboratory.
ar pr Ma	ill be located in the 30,000-square-foot, air-conditioned Building No. 6 t Research Park, where drafting facilities, and electronic laboratories re close at hand. Other engineering support laboratories include the

Melectronic Laboratory facilities provide ample space for electronic measuring and recording instruments, power supplies, and analytical instrumentation devices, which are available to the technicians and specialists in all areas. Within the overall electronic facilities are numerous fully equipped, specialized laboratories which are used in producing electroportical devices, in developing instrument servos, in fabricating support equipment, in effecting system integration, and in designing control systems. Melectronic Assembly Area Research Fark electronic assembly area occupies 2600 square feet. It is adaptable to the assembly of a wide range of electronic equipment, from microminiature subassemblies to aerospace ground equipment consoles. Current facilities at this location provide for flow or conventional soldering, welded subminiature connections, integrated wire preparation and processing, 3-dimensional wire harnessing, and microscopic assembly. Specialized processing facilities are available for welded modules, encapsulation, plating, cleaning, and other operations associated with advanced electronic assembly. Melectromagnetic Interference Test Laboratory. The Electromagnetic Interference Test Laboratory. Melectromagnetic Interference Test Laboratory. Melectromagnetic Interference Test Laboratory. The Arom, 20 by 20 by 10 feet, lined with sheet steel provides approximately 100 db attenuation from dc to 10 gc for module and component testing. System testing can be performed in a larger, double-copper-screen room, depending on the quantity of support equipment utilized. The Frequency range of 30 cps to 10 gc is covered by two sets of Class I upproved interference meters. Spectrum analyzer test equipment is available to cover the frequency range from 1 cps to 44 gc. Susceptibility restring can be accomplished with a set of signal generators, power generators, and power amplifiers that cover the range of 30 cps to 11 gc. Broadband noise and pulse generators are available to perform susceptibility and	
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In addition to a complete selection of conventional laboratory test instruments, equipment is available for measuring low-impedance bonds and grounds. A special	

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Calibration Certification of Test Equipment

All precision and electronic measuring equipment controlled to the requirements of "periodic inspection of measuring and testing equipment" is calibrated periodically to standards accountable through the National Bureau of Standards. The calibration methods are in conformance with the requirements of MIL-A-5958, Appendix NR520. The standard frequency rate for periodic calibration is adjusted to complexity and utilization of the equipment. Equipment is appropriately decaled to reflect the next cycle test requirement data.





0050

STANDARDS AND CALIBRATION LABORATORY

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DEVELOPMENT MACHINE SHOP

The Research Park development machine shop occupies 800 square feet and will fabricate the necessary parts for the proposed Rear Projection Viewer Project. The machining capabilities of the shop, expressed in tolerances achieved on work previously performed, are as follows:

Lathe:

 ± 0.001 inch normal machine practice and ± 0.0002 inch

by the use of special machining techniques

Grinder:

±0.0001 inch for cylindrical grinding

Jig Bore:

±0.00025 inch, rectangular coordinates

Mil1:

±0.002 inch

The specialists who staff the shop have worked with all machinable materials including aluminum, cast iron, magnesium, plastics, steel, invar titanium and Inconel. Among the many types of precision machine parts produced have been gimbals, platform castings, gears, housing cylinders, and shafts.



THE PROPERT MACHINE SHOP

METROLOGY LABORATORY

The Metrology Laboratory, temperature controlled at $69^{\circ} \pm 2^{\circ}$ F, provides precision measurements or tests of products or parts where accuracy must be in millionths of an inch. Equipment in the laboratory includes both the standard measuring devices of a metrology laboratory and specially designed equipment to meet the precision measurements required for the development and manufacture of Nortronics products.

The laboratory can provide accurate measurements in linearity to 10-millionths of an inch; roundness, perpendicularity, and flatness to 1-millionth of an inch through 360 degrees of rotation; angular measurements with an accuracy of 5 seconds of arc through 360 degrees of rotation; internal diameters to 20-millionths of an inch; external diameters to 10-millionths of an inch; angular deflection in 1/10 arc-second; optical flats to 1/8 fringe pitch radius and composite error of gears to 5-millionths of an inch; and gage block calibration to 1-millionths of an inch.

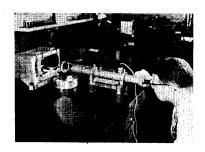
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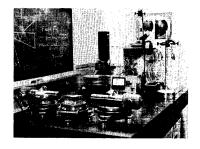


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METROLOGY LABORATORY

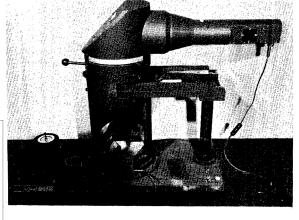


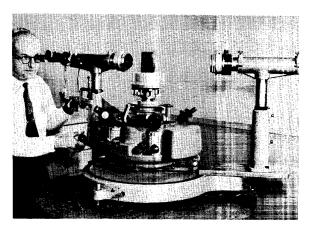




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PRECISION OPTICAL LAB EQUIPMENT

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· :		
:	OPTICAL LABORATORY AND FABRICATION FACILITIES	
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STAT	maintains extensive optical laboratory and fabrication facilities. The following paragraphs describe some of the equipment and methods in use.	
	The Precision Optical Laboratory occupies 4500 square feet and is fully equipped and staffed to perform optical design, fabrication, coating, assembly, and measurement. All visual metallic coatings can be applied, including those with high and partial reflections over specified portions of the spectrum. Laboratory equipment can also hold surfaces of 1/10 fringe flatness over 12-inch diameters. Angles and deviations of wedges are held to tolerances between 0.5 and 1.0 arc-second.	
	Special equipment in this laboratory includes: a developed electronic scanning system which detects 1/4 wavelength of magnesium fluoride with a change of less than 0.1 percent reflectivity per millimicron; Newtonian type and refracting telescopes; and a Twyman-Green interferometer.	STAT
	In addition, the laboratory has adesigned interferoscope; a l-arc-second Gaertner spectrometer; a Beckman spectrophotometer; and a Varian Associates VACION evaporating machine, controlled by a modified Jacquinot-Giacomo electronic monitor, for determination of optical thickness during deposition.	STAT
_	The Optical Development Laboratory offers a comprehensive facility for the research, design, and fabrication of advanced optical and electro-optical	
	systems. For this purpose various instruments are available, including precision autocollimators, angle dekkors, a precision spectrometer, optical flats, interferometers, microscopes, and special telescopes.	
STAT	optical design engineers utilize two Control Data G15-D electronic computers and a special plotting attachment for making rapid optical calculations and ray traces (See Section 8). Use of the computer for solving	
	the complex mathematical and analytical problems inherent in optical design permits considerable savings in engineering man-hours.	



1782

OPTICAL RAIL IN THE PHOTOMETRIC LABORATORY



COMPARISON PHOTOMETER

1.783

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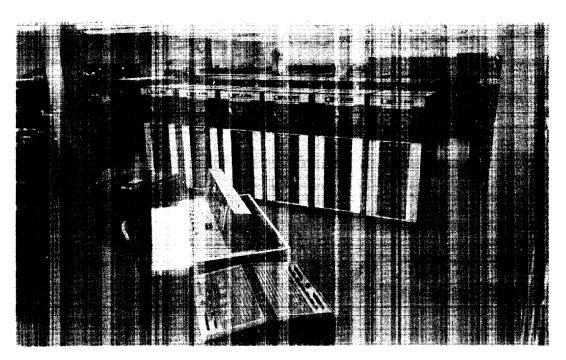
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in the industry. Using lamps certified by the National Bureau of Standard as its basic source of accuracy, this laboratory calibrates secondary standards, photometers, and light sources for research, factory checkout, and ground support equipment. Thus all photometric calibration are traceable to NBS. In addition to the NBS standards, photometric instruments are used to support Among these is a Model 13 Spectrophotometer for radiometric and spectroradiometric measurements; this instrument finds particular application in the development of new	4	
A complete in-house capability for the analysis of photometric requirement and the design and development of instruments and equipment exists within the Photometric Standards Laboratory, which occupies 2100 square feet. Facilities of the laboratory include: Radiometric standards facilities Darkrooms, including optical rails and accessories for mockups Electronic laboratories with the latest instrumentation Shop facilities for prototype development Spectrophotometers and accessories for radiometric studies, tests, and calibration Many types of photometers and simulators to calibrate or test systems under development. Photometric Standards Laboratory represents a unique capability in the industry. Using lamps certified by the National Bureau of Standard as its basic source of accuracy, this laboratory calibrates secondary standards, photometers, and light sources for research, factory checkout, and ground support equipment. Thus all photometric calibration are traceable to NBS. In addition to the NBS standards, photometric instruments are used to support Among these is a Model 13 Spectrophotometer for radiometric and spectroradiometric measurements; this instrument finds particular application in the development of new		
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optical processes and in the evaluation of optical components. designed instruments include star-sky photometer; photometer test set; photometric calibration set; star image autocollimator; and photometric evaluator.	support Spectrophoto this instrum optical proc designed ins photometric	Among these is a Model 13 meter for radiometric and spectroradiometric measurements; ment finds particular application in the development of new sesses and in the evaluation of optical components.



Analog Computer Center



IBM 7090 Computer

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DATA REDUCTION CENTER

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_	DATA REDUCTION CENTER	
STAT	Computers and their accessories are available to scientists and engineers at the Data Processing and Computation Center, which has the equipment and the personnel to provide every type of computing and data processing support for engineering and scientific projects.	STAT
	The principal digital computing and data processing equipment is an IBM 7090 Electronic Data Processor. This machine has a 32,000 word memory, 16 magnetic tape units, and a cathode-ray tube photographic plotter. As a supplement, three IBM 1401 peripheral computers have been installed. Complementary digital equipment includes conventional tabulating machines such as high-speed sorters, collators, tape-to-card and card-to-tape converters, reproducers and interpreters. readers, telereaders, and telecordex equipment comprise the data reading equipment.	25X1
STAT	The nucleus of the analog facility, adjacent to the digital room, consists of seven computing consoles and 64 channels of stripchart recording. The consoles are slaved to a centralized control desk from which automatic operations are monitored. Supplementary equipment includes 50 electronic multipliers and servo multipliers, 7 electronic resolvers and servo resolvers, 37 channels of diode function generators, a 5-channel electronic analog data sampler, and 4 x-y plotters (including the EAI 3033 Variplotter for digital and analog data).	
	TECHNICAL INFORMATION CENTERS	
STAT STAT	maintains well-staffed Technical Information Centers at its Each of these libraries contains hundreds of technical and scientific reference volumes, periodicals, journals, and trade magazines, together with card index files of material available from other sources. All files and reference lists are continuously updated.	
STAT	In addition to maintain its own Technical Information Centers, has access to all major libraries in Southern California and elsewhere in the United States, through the services of the Pacific Aeronautical Library (PAL) in Los Angeles. was among the charter supporters of the PAL, which was established under the auspices of the Institute of Aerospace Sciences (IAS). Now, like other companies in the aerospace and	STAT
STAT	electronics industries, subscribes to the PAL services on a unit charge basis.	
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ADVANCED REAR PROTECTION VIEWER